

Louisiana Department of Transportation and Development



**APPLICATION OF
QUALITY ASSURANCE SPECIFICATIONS
FOR
PORTLAND CEMENT CONCRETE AND STRUCTURES**

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**APPLICATION OF
QUALITY ASSURANCE SPECIFICATIONS
FOR
PORTLAND CEMENT CONCRETE AND STRUCTURES**

Developed by
TECHNOLOGY TRANSFER AND TRAINING
LOUISIANA TRANSPORTATION AND RESEARCH CENTER

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CREDITS

This manual was prepared by Dr. Tyson Rupnow, LTRC Associate Director of Research, with the assistance of the technical review committee listed below. The manual was edited and prepared for publication by Mr. Keith Beard, LTRC Training Section.

The material contained herein was approved for publication by the Department's Construction Division and the DOTD Chief Engineer.

Technical Review Committee

2016 Revised Edition

John Eggers

HQ Construction Division Area Engineer

Bert Wintz

Field Quality Assurance Administrator (Retired)

Phillip Graves

District 62 Area Engineer

B.J. Eckholdt

Quality Assurance Manager, Lafarge Concrete, N.A.

Mark Kelley

District 61 Laboratory Engineer

PREFACE

This manual is designed to standardize Department policies and procedures with reference to applicable areas (Part VI - Part X) of the 2016 *Standard Specifications for Roads and Bridges*. It is specifically written for routine DOTD cast-in-place portland cement concrete construction operations. It is not designed for application in areas requiring specialized techniques, such as concrete overlays, pavement rehabilitation, concrete recycling, etc. This manual details the responsibilities of the contractor and the Department with reference to the areas of certification, design, production, transportation, placement, quality control, inspection, and acceptance of pavements and structures built of portland cement concrete. It is to be used in conjunction with the following:

- CONTRACT DOCUMENTS – the legally binding written agreement between the DOTD and the Contractor setting forth obligations for the performance of work for a specific project.
- 2016 EDITION OF THE LOUISIANA STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES – (known as “*Standard Specifications*”) the terms and stipulations for providing materials, services, and the finished constructed product. (From the DOTD Intranet, Go to Publications/Manuals, to *Standard Specifications*, to 2013 Standard Spec...)
- MATERIALS SAMPLING MANUAL – (known as “MSM”) will be generated by Site Manager Materials arranged by Contract Item #, this includes the purpose, method of sampling, minimum frequency of sampling, sample quantity (size), sampling procedures, certificate requirements, and distribution of documentation.
(<http://www.dotd.la.gov/highways/construction/lab/sitemap.asp> , Go to 2015 Specs...)
- SAMPLING PLAN – will be generated using Site Manager Materials; a project-specific document denoting the minimum number of samples and certificates required for each contract item to ensure adequate representation and quality of all materials incorporated into the project. This is reviewed by the District Lab Engineer and/or the Project Engineer and is based upon the *Materials Sampling Manual*. (Sampling Plan is not on web site)

- SITE MANAGER MATERIALS MANUAL – User manual for completing and submitting the required documentation to accompany samples. (From the DOTD Intranet, go to Construction, then SiteManager Materials, Materials Documentation...)
- TEST PROCEDURES MANUAL – all standardized DOTD test procedures, which are denoted, “DOTD TR-xxx”.
(http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Materials_Lab/Pages/default.aspx , Go to Test Procedures Manual)
- ENGINEERING DIRECTIVES AND STANDARDS MANUAL – (known as “EDSM”) establishes policies and procedures for DOTD Design, Construction, and Maintenance. An example is “haul truck certification”. (From the DOTD Intranet, go to Publications/Manuals, to EDSMs (Engineering Directives and Standards.)
- APPROVED MATERIALS LIST (Quality Brand Name) (Formally known as “QPL”) – a listing of materials which have been prequalified by DOTD. This does not necessarily eliminate the requirement for testing.
(http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Materials_Lab/Pages/Menu_QPL.aspx , Go to Approved Materials List)
- DOTD CONSTRUCTION MEMORANDA – The DOTD’s internal office documentation to explain various construction issues. (From the DOTD Intranet, go to Construction Home Page, to Construction Memos)
- CONSTRUCTION CONTRACT ADMINISTRATION MANUAL – Instructions for DOTD Project Engineers and their representatives which include procedures for change orders, estimates, diaries, and field book entries. (From the DOTD Intranet, go to Construction, to Construction Contract Administration Manual)
- AASHTO TEST PROCEDURES – a set of nationally recognized test procedures and specifications published by the American Association of State Highway Transportation Officials. (Available at <http://www.transportation.org>)

- ASTM TEST PROCEDURES – a set of nationally recognized test procedures published by the American Standards for Testing and Materials. (Go to <http://www.astm.org>, Go to Standards, and then search. DOTD personnel may contact the District Lab Engineer.)
- ADMINISTRATIVE MANUAL FOR CONSTRUCTION TECHNICIAN TRAINING AND CERTIFICATION – certification and training requirements for performing construction inspection. (http://www.ltrc.lsu.edu/pdf/2008/admin_manual_final08.pdf)

These publications are used together to ensure that portland cement concrete operations are performed in accordance with all DOTD specifications, policies, and procedures. For precast-prestressed plant operations, refer to the DOTD *Application of Quality Assurance Specifications for Precast-Prestressed Concrete Plants* manual.

For the purposes of this manual the term "certified technician" is the authorized representative of the contractor. The term "certified inspector" is the Department's authorized representative.

Examples of forms and specification requirements in this booklet are based on the 2016 *Standard Specifications for Roads and Bridges*. Relevant specifications are referenced throughout this manual. Specifications may be repeated in order to further detail or demonstrate how they are applied. **All specifications, manuals, forms, and spreadsheets are subject to change. Therefore, it is imperative that contract documents for each project be reviewed for any specific change, update, and/or addition.**

SPECIFICATION CHANGES

This manual is referenced in those areas of the *Standard Specifications*, which are concerned with cast-in-place portland cement concrete; therefore, it must be consulted for elaboration of areas of specification change and DOTD construction techniques and procedures which are presented in more detail than is possible in the *Standard Specifications*. The English System for units of measure is the standard for this manual.

The primary changes regarding portland cement concrete pavement and structural concrete construction are:

- Three Classes of Structural Concrete (A, A2, A3)
- Three Classes of Prestressed Concrete (P1, P2, P3)
- Three New Classes for Mass Concrete (MASS A1, MASS A2, MASS A3)
- Longitudinal Surface Tolerance Requirements will be measured by IRI (See DOTD TR644)
- Surface Resistivity testing is now required for all structural class concretes (See DOTD TR 233)
- The hot and cold weather limitations have significantly changed. (See Section 901.11)
- Substitutions of cementitious materials has significantly changed
- The percent air content by volume requirements have changed
- There is no minimum cementitious material requirement

The payment adjustment schedules were not developed for the benefit of the contractor, but as a mechanism by which the Department can accept the product and pay the contractor on those rare occasions when the portland cement concrete product does not meet all Department requirements. The payment adjustment schedules included in the *Standard Specifications* are to be considered as a method of payment to the contractor for a substandard product. Under these specifications, the production of portland cement concrete at less than 100 percent payment will not be allowed on a continuous basis. If test results demonstrate that payment adjustments are necessary, or other specification requirements are not being met, satisfactory control adjustments shall be made or production shall be discontinued.

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**APPLICATION OF QUALITY ASSURANCE SPECIFICATIONS
FOR PORTLAND CEMENT CONCRETE PAVEMENT AND
STRUCTURES**

CHAPTER 1 - QUALITY ASSURANCE

The concept of quality assurance refers to the combined efforts of quality control and quality acceptance processes to assure that a project will provide the public with a durable product exhibiting a high level of performance. Quality control is the process used by the contractor to monitor, assess, and adjust material selection, production, and project construction to control the level of quality so that the product continuously and uniformly conforms to specification. Quality acceptance is the process of sampling, testing, and inspection to determine the degree of compliance with specifications for acceptance of materials and/or contractor's work. To this end, a system of inspection by qualified personnel (both Department and contractor) and statistically based sampling and testing has been established. To ensure that the quality assurance concept functions properly, it is critical that the contractor's quality control and the Department's inspection and acceptance process be a cooperative, coordinated effort. **When any part of the process fails, the contractor's risk for payment adjustments and the Department's risk of accepting substandard work increase. The increase of these risks caused by a failure on the part of either the contractor or the Department is unacceptable.**

The obvious concept behind statistically based testing is the determination of project quality in terms of a specific parameter by a randomly distributed number of tests. Some element of risk exists for both the Department and the contractor; however, historical data has established that this risk is minimal and evenly distributed. **Additional tests are not to be performed unless it is clear that the initial statistically-based test result is from a sample taken that is not representative of the lot.**

The performance of random quality control and acceptance testing in no way relieves the contractor of the duty to produce a consistently uniform product meeting all specification criteria; nor does the performance of random acceptance testing relieve the Department from requiring the correction of any deficiencies, identified during the inspection process, that fall outside a test location. **Both contractor and Department personnel are duty bound to visually inspect all**

aspects and areas of the project for uniformity and to ensure that the project is free of defects. The testing program is designed to support, not replace, visual inspection.

Quality assurance specifications are not "end result." It is not the intent of quality assurance specifications to allow the contractor to use construction practices or materials that may lead to a less than quality product. If the contractor attempts to achieve only the minimum criteria for which the Department will allow 100% payment, the risk of the discontinuance of operations and/or payment adjustments will be significantly increased due to the nature of statistically based acceptance parameters. The Department will not allow continued operations when tests result in less than 100% payment or show less than minimum specification requirements when no payment adjustment is applicable.

CONTRACTOR'S RESPONSIBILITIES - QUALITY CONTROL (QC)

The contractor is responsible for meeting all specification requirements. The contractor shall employ competent trained personnel and provide equipment that is in good condition and appropriate for the tasks for which it is used. When no minimum QC sampling and testing program is specified, the minimum acceptable schedule of QC sampling and testing will be the same as performed by the Department for acceptance.

The contractor will locate, select, process, and place uniform materials meeting specification requirements. The contractor will sample and test the materials and final product to ensure that no failures will be identified by the Department during inspection or acceptance testing. At or no later than the preconstruction conference, the contractor is to provide the project engineer with a list of quality control personnel, their assigned responsibilities, and their prior experience in their areas of responsibility, the types of equipment proposed for the various construction activities, and a proposed quality control program, including a basic schedule of layout, sampling and testing and the testing equipment to be used. If the contractor is unable to provide details at the preconstruction

conference, these topics are to be thoroughly discussed. The contractor will not be permitted to begin construction until this information is approved by the project engineer. If changes to personnel or any other aspect of the QC program must be made, the contractor must notify the project engineer immediately.

The contractor is to obtain copies of appropriate Department documents, manuals, and forms needed for the work. Such documents and manuals may include specifications, plans, contract, *Materials Sampling Manual*, *Testing Procedures Manual*, *Quality Assurance Manual*, etc., and shall be made available to the field representatives on the project. The project engineer will provide information on how to obtain these documents or order the documents directly from LA DOTD's General Files Unit, Post Office Box 94245, Baton Rouge, LA 70804-9245. Many of these documents, manuals, and forms can be found on the Department's website - www.dotd.la.gov.

PERSONNEL

Specifications require that the contractor provide a Certified Concrete Technician who is to be at the plant or job site whenever a plant supplying concrete for DOTD projects is in operation. These requirements are waived when the contractor is placing only minor structural class concrete.

Outside of the above concrete quality control requirements, it is recommended that the project QC personnel complete the Department's training materials in their areas of responsibility. It is imperative that QC personnel be thoroughly familiar with Department specifications, policy and procedural documents, and sampling and testing procedures. The contractor will require that personal safety equipment be used as appropriate, including the wearing of film badges by nuclear device operators, should they be operated by QC personnel.

Each equipment operator will be fully knowledgeable of the safety features, limitations, and uses of the machine. Personnel employed by the contractor to operate equipment will be properly trained in its operation and be capable of using the equipment to ensure compliance with plans and specification requirements. For example, operators of placement and finishing equipment

will know how to adjust the equipment to obtain proper grade and alignment of the pavement surface and proper frequency and position of internal vibrators.

It is critical for the rideability of portland cement concrete pavements and structures that placement and finishing equipment be properly operated. Failure to operate placement or finishing equipment properly may cause the structure or pavement surface not to meet specification requirements for thickness, strength, or rideability.

DIMENSIONAL CONTROL

The contractor will routinely check alignment and grade (when applicable), thickness, and cross section to ensure that layout matches the plans. These checks shall be in accordance with standard survey practices or published DOTD procedures. Such checks will be made at intervals of adequate frequency to ensure that alignment and grade, and thickness do not exceed specification tolerances.

MATERIAL QUALITY

It is the contractor's responsibility to locate and furnish materials which meet specifications. It is also the responsibility of the contractor to ensure that those materials, after being processed, placed, and consolidated, will meet Department acceptance criteria. The contractor is required to select materials from sources listed as approved for portland cement concrete on the Approved Materials List (Qualified Products List). **The contractor is responsible for coordinating with the project engineer and the district laboratory engineer the arrangements for materials acceptance testing and approval along with the planned work schedule.** The contractor is to schedule work so that the laboratory or project engineer can arrange the sampling and testing of materials prior to their planned incorporation into the project. Failure to do so will result in a delay of the contractor's proposed schedule, since no material can be placed on a project without approval. When scheduling work, the contractor must consider the additional time required for the approval of materials which must be tested by the Materials and Testing Section in Baton Rouge.

SAMPLING AND TESTING

The contractor will conduct tests during the progress of the work to ensure continuous compliance with specifications. The contractor is to take as many samples and perform as many tests as necessary to ensure that materials and processes are producing a uniform product within the specification limits. When test results are near the borderline of specifications, the contractor is advised to adjust operations and/or materials sources to ensure that materials meet specifications, and that borderline conditions do not continue. Materials and operations at the borderline of specification requirements often result in failing acceptance tests, which can result in payment adjustments, loss of production time, and significant alterations to the QC program. When borderline materials or operations result in failing acceptance/verification tests, immediate adjustments will be required. The contractor will use test procedures and methods which correspond with the Department's quality assurance program. These procedures are designated in the *Specifications*, *Testing Procedures Manual*, and *Materials Sampling Manual*. The project engineer will provide the contractor with appropriate *EDSM* or other directives.

Testing equipment must be appropriately calibrated and in good working condition. The contractor will contact the district laboratory engineer for policies and procedures to be followed for each piece of testing equipment. Furthermore, to ensure awareness for placement and joint sawing operations for PCCP, the contractor will be responsible for monitoring the components (cement, mineral and chemical admixtures, aggregates) in their mix to protect against any changes due to component variations. As component shipments arrive, the contractor will verify slump, air content, and initial set times by testing at ambient temperatures. The contractor will make adjustments to the mix design to rectify any changes which would adversely affect constructability, concrete placement, or compliance with the specifications. The contractor shall submit test results to the Department for review. Testing to validate component consistency will be documented on the control logs. Conformance or variation in mix parameters (workability, set times, air content, etc.) will be noted on the control logs. The contractor shall provide a copy of the proposed testing plan to the engineer for record. Acceptance of the plan does not relieve the contractor's responsibility for consistency.

The contractor is not to wait until a change in materials or a test result from DOTD indicates a deficiency, but is to stay continually abreast of construction progress and activity. When the contractor identifies failing materials or processes, the contractor shall take whatever measures are necessary to correct the deficiency and prevent its recurrence. These measures shall include, but are not limited to the following:

- removal of personnel or equipment not performing in an acceptable manner
- removing and replacing materials
- locating and selecting other material sources
- reprocessing the deficient area
- additional testing both to establish the total limits of the deficient area and to ensure that corrective action has been successful

The contractor is to complete QC testing and make any needed corrections prior to requesting acceptance testing by the Department. The contractor is not to rely on the Department's acceptance program and acceptance test results to prevent the application of payment adjustments or delays caused by suspensions of operations due to failures or deficiencies. **The contractor is to document all QC testing and provide copies to the Department as directed. All QC documents must be clearly labeled "QC"**

RESPONSIBILITIES OF THE PROJECT ENGINEER

The project engineer is the legal representative of DOTD for the administration of the contract and represents the Department directly as well as through the inspection staff. The Department is responsible for inspecting, sampling, and testing for acceptance/verification. The process of inspection and acceptance is continuous. The Department evaluates the contractor's construction process, materials, personnel, equipment, and quality control program to determine if specifications are being uniformly met. Additionally, the Department takes samples and conducts tests to ensure that the contractor's QC test results are accurate and reflect the actual quality of the product. **The Department's results are used to determine the acceptability of**

the product and take precedence over any other test results. Any deficiency identified by the Department through inspection, sampling, and/or testing will be corrected by the contractor at no direct pay. **Consistent or repeated failures identified by test results or repeated deficiencies identified by inspection will result in the suspension of operations until the cause is identified and corrected, and the QC program is reviewed and modified to eliminate such repeated or consistent failures.**

MONITORING QUALITY CONTROL (QC)

At the preconstruction conference, the project engineer is to review the contractor's proposed QC program and provide a copy to the district laboratory engineer. The project engineer may require the contractor to modify the proposed program either at the preconstruction conference, before construction begins, or during construction. The project engineer may allow a reduction in the number of tests required in the approved QC program, but not less than the minimum frequency or quantity required by specifications directly or through the *Materials Sampling Manual*. When acceptance inspection or tests indicate that the contractor's QC program is not effective, modifications to the program will be required. The project engineer has the right to reject personnel, equipment, construction methods, testing methods or frequencies that are not resulting in an acceptable project. **The contractor will not be allowed to proceed with construction operations without an effective, approved QC program.**

The project engineer will be certain that the contractor's representative on the project has the appropriate Department documents and manuals, such as the specifications, plans, contract, *Materials Sampling Manual*, *Testing Procedures Manual*, and the latest edition of the *Quality Assurance Manual* as well as the appropriate DOTD forms.

Evaluations of the QC effort to ensure that additional failing acceptance tests do not occur may include, but are not limited to, the following:

- Observation of the contractor's sampling and testing procedures
- Evaluation of the contractor's testing equipment
- Observation of construction procedures

INSPECTION

Personnel

The project engineer is responsible for providing qualified inspectors on the project. Each inspector will successfully complete the Department's training materials for the level of responsibility assigned. The chief inspector at the project site will be certified in Portland Cement Concrete Paving Inspection or Structural Concrete Inspection, as applicable, and is recommended to visit the plant daily.

The project engineer is responsible for checking that QC technicians are trained and/or certified as required.

Equipment

Prior to construction, the project engineer will inspect the equipment to be used on the project to ensure that it is in good condition and appropriate for the activity for which it is to be used. Equipment required by specifications or weight laws to be certified must be properly identified and certified. The project engineer is to require that equipment which leaks or is damaged be repaired or replaced before it operates on the project. The project engineer is to require the replacement of equipment that is not appropriate for the project prior to its being used.

During the progress of construction, construction personnel are to inspect equipment daily to ensure that it has been maintained in good condition and that no damage which would affect its operation has occurred. Damaged equipment must be repaired prior to its continued use. Project personnel will evaluate the effectiveness of equipment. Equipment which does not perform properly or which does not produce a quality product that meets specifications is to be replaced with acceptable equipment.

ACCEPTANCE

Visual Inspection

Although the random, statistically-based sampling and testing performed by the Department represents the entire area being tested, this methodology does not replace visual inspection. Department personnel will observe the contractor's operations and inspect the project throughout its construction. When non-uniform materials or non-uniform processes result in areas which do not appear to be acceptable or which are obviously not in conformance with the quality of construction expected, the Department will require the contractor to correct these deficient areas. Such deficiencies for portland cement concrete paving or structure concrete construction may include segregation, contamination, excess laitance or bleeding, poor consolidation, elevation and alignment problems, incorrect tining, and dowel/tie bar placement that is inaccurate or unsecure.

It has never been the intent of the Department to accept a project solely on the basis of the statistically-based sampling and testing program. It is always necessary for the project engineer and inspector to be aware of the quality of construction and performance of the project during construction and acceptance phases before final acceptance.

Visual inspection includes base preparation, forms, reinforcing steel placement, tie, and dowel bar placement, all concrete placement, consolidation, finishing and curing, and other aspects of the project to ensure conformance to plans and specifications.

Sampling and Testing

Sampling and testing is a support for visual inspection. Project personnel will sample and test material for acceptance in accordance with the Project Sampling Plan, based on the schedules published in the *Materials Sampling Manual*. It is to be noted that the *Materials Sampling Manual* establishes the minimum frequency and quantities of sampling and testing at the required level. The engineer has the authority to require additional tests to ensure uniformity, acceptability, and quality of the work. **When samples or tests yield failing results the contractor shall correct the area represented by the sample or test, unless the specifications allow the application of payment adjustments. Materials are to be sampled, tested, and approved prior to incorporation into the project. Materials which do not meet specifications shall not be placed.**

A copy of the Department's Sample Identification (03-22-0800) is reprinted in the Appendix on pages B-3 and B-4.

Acceptance sampling and testing is to be performed by Department personnel independently of the contractor's QC program. The inspector is not to use the contractor's QC test results as the Department's acceptance

RESPONSIBILITIES OF THE DISTRICT LABORATORY

The district laboratory engineer is the coordinating authority of the district's quality assurance program and is the legal representative of the Department in the area of materials quality. The district laboratory is responsible for assuring that the quality assurance program is applied uniformly. This coordination of the QA program is performed in conjunction with the DOTD Materials Engineer Administrator. The district laboratory has specific and implied responsibilities, including but not limited to the following:

- Administer the district Quality Assurance Program
- Certification of and inspection of portland cement concrete plants
- Certification or approval of testing equipment
- Evaluation of the qualifications of DOTD employees and personnel associated with DOTD construction
- Assisting and providing expertise for construction processes and problem solving
- Establishing the Project Sampling Plan
- Identifying the appropriate test to be performed
- Identification of proper sampling and testing techniques
- Interpretation of test results
- Sampling and approving project material sources
- Acceptance testing for selected parameters (e.g., surface tolerance, surface resistivity, flexural strength, etc.)
- Coordination of application of Project Sampling Plan
- Project Materials Certification (2059 Review)
- FHWA mandated Independent Assurance Sampling and Testing
- Mix Design Approval
- Portland Cement Concrete Paving Lot Layout (in conjunction with the Project Engineer)
- Portland Cement Concrete Paving Thickness and Strength Testing (Determination of percent pay by select districts)

RESPONSIBILITIES OF THE MATERIALS AND TESTING SECTION

The Materials and Testing Section is responsible for updating sampling and testing procedures, providing lists of approved materials sources, performing acceptance and verification testing on materials not tested by the district laboratories or project engineers, testing materials for inclusion on approved source lists, and distributing the *Materials Sampling Manual*, *Testing Procedures Manual*, *Approved Materials List*, and Site Manager Materials documentation. For PCC paving, the Materials and Testing Section/District Laboratory Engineer is responsible for determination for percent pay based on thickness, strength, and smoothness. **When no specific sampling or**

testing is referenced, the Materials Engineer Administrator will determine the appropriate sampling frequency, methods, and tests to be used. The Materials and Testing Section also provides technical support to district construction and materials forces.

DEDICATED STOCKPILES

A dedicated stockpile is defined as a stockpile built for a specific project. It is sampled, tested, and approved during its construction. Dedicated stockpiles are to be constructed in final position. If the engineer allows the contractor to move material from a dedicated stockpile, except for placement in the project, such disturbance will be at the contractor's risk. The disturbed material will be subject to additional approval sampling and testing. If the disturbed material has become contaminated, segregated or fails specification requirements when retested, it will not be placed in the project.

The contractor may attempt to correct any deficiency in a disturbed stockpile, which has failed subsequent approval testing, at no direct pay. If the contractor is unable to correct the deficiency, the material will not be used on the project.

Material in dedicated stockpiles may be used only on the project for which it has been dedicated, unless otherwise approved in writing by the project engineer. Once a dedicated stockpile has been approved by the Department, no material can be removed or added without the approval of the project engineer. **The project engineer will not approve the addition of material to a dedicated stockpile until such material has been sampled, tested, and approved to be placed in the stockpile.** Material which is approved for addition to a dedicated stockpile will be sampled and tested under the same conditions as the dedicated stockpile. To avoid the risk of the Department rejecting a disturbed dedicated stockpile, in lieu of requesting that material be added to an existing dedicated stockpile, the contractor is expected to make every effort to create a new stockpile.

During the construction of a dedicated stockpile, the engineer will sample the stockpile in accordance with the *Materials Sampling Manual* and submit the samples to the district laboratory for testing. It will be the responsibility of the contractor to notify the project engineer and request sampling and testing during stockpile construction and to keep the project engineer and district laboratory engineer apprised of the building schedule of stockpiles to be dedicated. Failure to do so can result in the rejection of the stockpile, disallowance of or substantial delay in advance payment for the materials, or substantial delay in the construction process.

NONDEDICATED STOCKPILES

Stockpiles which are not dedicated for use on a specific project are nondedicated. Advance payment will not be made for materials in nondedicated stockpiles. In general, nondedicated stockpiles are those to which material is randomly added or removed, or which will subsequently be moved to another location. Nondedicated stockpiles remain in the control of the contractor. Materials from nondedicated stockpiles are sampled and tested as it is used in accordance with the *Materials Sampling Manual*.

CHAPTER 2 - CERTIFICATION

PLANT

All plants supplying portland cement concrete paving and structural mixtures to DOTD projects must be certified by the district laboratory except Pre-cast and Prestress Plants which produce portland cement concrete strictly for their own use will be certified by the Structural Fabrication Engineer. Plant certification requires an in-depth inspection by district laboratory personnel or Structural Fabrication Engineer personnel to ensure that the plant's equipment, stockpiles, storage bins, plant laboratory, etc., are in conformance with Department specifications and standards. It is advisable that engineering staff involved with construction projects receiving material from the plant being inspected participate in the certification process to ensure that the requirements of both the specifications and individual contracts are met. This inspection is a preliminary to the actual granting of certification. Certification by the district laboratory signifies that the plant is capable of producing portland cement concrete mixtures that meet Department standards of quality. Therefore, in order to receive final certification, a plant must be in a production mode and able to demonstrate its performance. As a part of this inspection, routine sampling and testing by contractor and Department personnel will be observed to determine if inconsistencies or other problems are a direct result of plant, equipment, or batching operations. The plant owner must notify the district laboratory or the Structural Fabrication Engineer so that arrangements for certification can be made.

Certification inspections are documented on the *Portland Cement Concrete Plant Certification Report: 03-22-4030*. The completed form will be filed at the district laboratory or Structural Fabrication Engineer's office. A copy of this form is reprinted in the Appendix on pages B-5 through B-14.

After initial certification, the plant must continue to conform to the requirements for certification during all subsequent inspections. **Certification is valid for a two year period, provided that**

the plant is maintained in accordance with the conditions under which certification was issued. District laboratory personnel will review the plant's performance and documentation for conformance to certification requirements every ninety calendar days, or more frequently if equipment or processes are modified. It is the responsibility of both contractor and Department personnel to notify the district laboratory or Structural Fabrication Engineer when modifications are made to either equipment or processes.

The revocation of certification shall be at the discretion of the certifying district laboratory engineer.

Plants producing **only** minor structure class concrete must meet all certification requirements except the approved laboratory and certified technician. The quality control program must keep the mixture within specification requirements. The plant certification sticker will identify the plant as certified to produce minor structure concrete only. Classes M and R are Minor Structure Concrete.

SCALE AND METER CALIBRATION

In accordance with EDSM III.1.1.16 and the *Standard Specifications*, the contractor is required to have all scales and metering devices calibrated every ninety days and certified by the Weights and Measures Division of the LA Department of Agriculture and Forestry or an approved independent scale service. This certification, stating that the equipment meets all Department requirements for accuracy, must be submitted no later than 10 business days after the due date to the district laboratory engineer on the *Certification Report for Scales and Meters: 03-22-3065*. A copy of this report is reprinted in the Appendix on page B-15. Scales will be checked in a conventional manner using known weights of sufficient size to check the scale system in its upper ranges.

When a calibration service/technician located outside of Louisiana must be used to calibrate a scale or metering device, the service/technician must be licensed by the state where the service/technician is located under standards similar to those required by Louisiana and approved

by the DOTD Materials Engineer Administrator. When a calibration service/technician located within the geographic borders of Louisiana calibrates a scale or metering device, the service/technician must be licensed by Louisiana in order to calibrate scales and metering devices for the Department.

In accordance with Section 901 of the *Standard Specifications*, all scales must be accurate to 0.5 percent throughout the range of use. Additionally, the maximum graduation on scales will be 0.1 percent of rated scale capacity. If a scale is used to weigh water for batching, the scale must be accurate to 1 percent at 1/2 the maximum allowable water per batch. If a meter is used to measure water for batching, the meter must be accurate to 1 percent at 1/2 the maximum allowable water per batch.

TRUCKS

All trucks delivering portland cement concrete, including minor structure class concrete, to DOTD projects will be certified by the district laboratory. Truck certification requires an in-depth inspection by district laboratory personnel to ensure that the truck meets specification requirements documented on the *Portland Cement Concrete Truck Certification Report: 03-22-4045*. The completed form will be filed at the district laboratory. A copy of this form is printed in the Appendix on pages B-17 through B-20.

Truck certification frequency:

- Truck Mixer (Every 2 Years)
- Agitator Hauling Equipment (2 Years)
- Non-Agitator Hauling Equipment (Once)
- Portable Volumetric Mixers (6 Months)

District laboratory personnel may review the truck for conformance to certification requirements at any time, if equipment or processes are modified. It is the responsibility of both contractor and

Department personnel to notify the district laboratory when modifications are made to either equipment or processes. Additionally, all trucks must be certified in accordance with EDSM III.1.1.12 to establish each truck's legal load.

PERFORMANCE INSPECTION

Official certification and performance evaluation inspections do not release the inspector from the responsibility of monitoring performance on a daily basis during production for DOTD projects. If equipment fails to perform satisfactorily or is not maintained in acceptable condition, the inspector is to notify the project engineer and the district laboratory engineer. Furthermore, the Department's certified inspector has the authority to temporarily revoke the certification of any plant or truck which fails to meet certification standards. In such a circumstance, the certifying district laboratory engineer must be notified immediately. Only the certifying district laboratory engineer can remove a certification sticker from a certified plant or truck. Certification will be reinstated by the district laboratory engineer after corrections have been made and all certification requirements met. In the event of a serious malfunction of equipment, the certified inspector has the authority to refuse to accept material produced or delivered by the defective equipment.

Revocation of Plant or Truck Certification

If a plant or truck fails to conform to Department standards under which certification was issued, the certification will be revoked. Certification can be revoked by the certifying district laboratory engineer. **Once certification has been revoked, the plant or truck will be prohibited from supplying or transporting mix for any Department project until all deficiencies are corrected and certification is reinstated by the district laboratory engineer.** If the plant is supplying concrete across district lines and is failing to produce a satisfactory mixture or is no longer in conformance with Department certification standards, the project engineer or district laboratory engineer in the district to which concrete is being delivered will immediately notify the certifying district laboratory engineer, so that certification can be revoked. **The certified inspector will not accept concrete that is deficient or that is being delivered from a plant or by a truck that is not in conformance with Department certification standards.**

PERSONNEL

DOTD PERSONNEL

A DOTD Certified Inspector will be present at the job site during construction activities incorporating portland cement concrete produced under Section 901. The inspector will be certified in the specific construction area (structural or paving inspection). The certified inspector is also responsible for reviewing the contractor's coordination of plant production with on-site construction activities to ensure conformance to the specifications and Department policies.

Certification is awarded by the Department upon satisfactory completion of examinations and evaluation. Six months on-the-job training under the direction of a certified inspector, in all phases of structural or paving operations with portland cement concrete, is required before an applicant is considered eligible for certification testing. Arrangements for certification testing should be made through the respective District Training Office.

The Materials Engineer Administrator is the certifying authority for the Department. The Materials Engineer Administrator has full authority to grant or to revoke certification.

If for any reason a DOTD Certified Inspector is performing substandard work, proceedings to revoke certification can be initiated by the district training specialist, district laboratory engineer, project engineer, or area engineer. The request that certification be revoked must be directed to the Materials Engineer Administrator and be accompanied by documentation of the unsatisfactory performance. The request will be evaluated by the Certification Committee. When revocation is due to substandard work performance, the applicant must present the Certification Committee with evidence that the unsatisfactory performance has been corrected and will not be repeated before recertification can be attempted. When certification is revoked, complete requalification and retesting will be required before recertification will be granted.

NONDEPARTMENT PERSONNEL

NonDepartment personnel are certified and authorized by DOTD. A Certified Concrete Technician must be present at the plant or job site when the plant is in operation. The terms "certified" and "authorized" means that the technician is experienced in this field, and has successfully completed the Department's testing requirements and is capable of performing all tasks required by Subsection 901.06, *Standard Specifications*, in a manner acceptable to the Department. **If a Certified Concrete Technician or an Authorized Concrete Field Tester does not satisfactorily demonstrate the ability to perform the duties as stipulated in Subsection 901.06, the Technician or Tester will not be allowed to be involved in the production or placement of concrete mixtures for the Department. Personnel with a current ACI Concrete Field Testing Technician Grade I certification qualify as an Authorized Concrete Field Tester.**

A certified technician is not required for the production of minor structure class concrete; however, mix designs, even for minor structure concrete, must be prepared by a certified technician.

If a Certified Concrete Technician is not available at the job site, an Authorized Concrete Field Tester will be allowed to perform control tests for temperature, slump, and air content; to mold cylinders for compressive strength testing; to add water to the concrete mixture at the job site; and report the results to the Certified Concrete Technician. An Authorized Concrete Field Tester is defined as a person who has demonstrated the ability to perform the preceding tasks in accordance with the Department's standard procedures for the concrete being placed to the satisfaction of the Department. The use of an Authorized Concrete Field Tester will not relieve the Certified Concrete Technician from performing the remaining duties outlined in Section 901, *Standard Specifications*.

If for any reason a Certified Concrete Technician or Authorized Field Tester is performing substandard work, proceedings to revoke certification can be initiated by the district training specialist, district laboratory engineer, project engineer, or area engineer. The request that

certification be revoked must be directed to the Materials Engineer Administrator and be accompanied by documentation of the unsatisfactory performance. The request will be evaluated by the Certification Committee. When revocation is due to substandard work performance, the applicant must present the Certification Committee with evidence that the unsatisfactory performance has been corrected and will not be repeated before recertification can be attempted. When certification is revoked, complete requalification and retesting will be required before certification will be reissued.

CHAPTER 3 - LOT ESTABLISHMENT

Lots are used for the purposes of acceptance testing for surface tolerance, thickness, and compressive strength.

PAVEMENT AND SHOULDERS

A lot of portland cement concrete pavement or shoulders is an identifiable area of approximately 4,000 yd² paid under the same item number. The final area of pavement placed will be considered as a lot if it is at least 2,000 yd²; otherwise, it will be included in the previous lot. A lot may consist of either a single day's operation, a portion of a day's operation, or a combination of several days' operations.

Small, irregular areas with the same plan thickness and item number, including intersections, entrances, crossovers, etc., will be grouped together to form lots. Each lot will be approximately 4,000 yd².

It is the intent of the specifications that lots be as close as possible to 4,000 yd². It is not the intent of the specifications that lot sizes be artificially manipulated for the consideration of payment adjustments. The word "approximately" in this specification is intended to provide the engineer with the flexibility needed to establish lot limits that are easily identifiable and reflect the actual construction methods of the project.

When concrete is placed monolithically in areas which must be paid under more than one item number, as in portland cement concrete pavement and shoulders, the boundaries of the lots must be based on each item number. For example, separate lots must be established for pavement and shoulders. They would not be grouped together, although placed at the same time. Shoulders and travel lanes have different requirements for thickness and surface tolerance and

have different item numbers.

LOT LAYOUT FOR PAVEMENT AND SHOULDERS

The lot divisions are to be established prior to the beginning of paving operations whenever possible. The Project Engineer and the District Laboratory Engineer will jointly establish these divisions based on the plans and the construction method to be utilized by the contractor. These divisions are to be delineated by station numbers and sketches. Lot limits are also to be clearly identified on the project, so that coring locations can be accurately determined. A concrete pavement lot should be as continuous as possible; however, exceptions that occur shall be subtracted from the total area, so that the actual lot quantity will reflect the requirements of the specifications. When continuous lot sequences are interrupted by structures, ramps, or other areas that may be considered exceptions, the lot will be interrupted and an exception noted for the affected area. **Pavement areas with different plan thicknesses will not be grouped together in the same lot.**

PROJECTS TOTALING LESS THAN 2,000 yd²

The *Materials Sampling Manual* allows the application of the small quantities rule to portland cement concrete pavement when the total contract quantity of pavement, shoulders, ramps, and irregular areas is less than 2,000 yd² for the entire project. A project requiring less than 2,000 yd² of portland cement concrete may be accepted on cylinders or cored and tested. If the project engineer chooses to make cylinders in order to test for compressive strength, three cylinders will be made per 100 yd³ of concrete and tested. Cylinders will be made in accordance with DOTD Designation: TR 226 and tested in accordance with DOTD Designation: TR 230. When concrete cylinders are used to determine the compressive strength of the lot, thickness measurements shall be based on standard inspection or survey practice. If there is any question about thickness or problems with the cylinders, the project can also be cored.

The project engineer must notify the Materials Engineer Administrator, in writing, if cylinders are to be used in lieu of pavement cores for the determination of payment. If the

project engineer plans to use cores for the determination of payment, the same procedures outlined for a standard sized lot shall be followed.

STRUCTURAL

A concrete lot for structural activities is an identifiable placement (pour) of the same class of concrete which must not exceed 200 yd³. An identifiable placement is to be delineated in such a way that if the concrete must be removed, the limits of each lot of concrete represented by the failing tests can be readily identified. For sampling and testing purposes, placements exceeding 200 yd³ of concrete but not exceeding 400 yd³ will be divided into two lots of approximately equal size, while maintaining the identity of each lot. A placement exceeding 400 yd³ will be represented by three lots of approximately equal size, while maintaining the identity of each lot.

It should be noted that for structural concrete activities, the lot size controls the schedule for sampling and testing.

MINOR STRUCTURE CONCRETE

A lot of minor structure concrete is considered to be any combination of placements equal to 50 yd³ or less, per class per plant. The amount of mixture produced to equal a lot of minor structure class concrete may be placed in different locations, used in different items of the contract, and may be produced on more than one day. The location(s) of each lot of minor structure concrete must also be readily identifiable, so that in the event of nonconformance to specifications requiring that the concrete be removed or a payment adjustment applied, the affected areas or items can be isolated.

CHAPTER 4 - MIX DESIGN

SUBMITTAL PROCEDURES

PAVEMENT OR STRUCTURAL, INCLUDING MINOR STRUCTURE

A mix design will be required when a plant produces portland cement concrete for DOTD. Mix designs will be required for each different type or class of concrete produced for each project for each plant. (Pavement concrete is designated by type and structural concrete and minor structure concrete is designated by class.) Mix designs should be in accordance with Section 901.06.1 of the *Standard Specifications*. Mix designs must be resubmitted whenever significant changes are made to the mix design to bring a mixture back into conformance. Minor mix adjustments are allowed in accordance with Section 901.06.3 of the *Standard Specifications*.

Approval of the mix design by the district laboratory is required before any mixture can be produced for the Department. It is the responsibility of the contractor to submit the mix design to the district laboratory engineer. The proposed mix design must be submitted on a properly completed Portland Cement Concrete Mix Design form: 03-22-0735. An example of the mix design form for Class AA structural concrete, with admixtures, is shown in the Appendix on page B-21. Completed and filled out properly, it may also be used to submit mix design for Type B pavement mixture, with admixtures.

The district laboratory will accept the general mix design and assign a sequence number. The accepted mix design will be returned to the submitter for future use on specific projects. Rejected mix designs will be marked "rejected" and returned to the submitter without a sequence number. Rejected mix designs shall not be used on DOTD projects.

Acceptance of the mix design by the district laboratory is based on the following criteria:

- Absolute Volume not over 27.00 ft³
- Water-Cementitious Materials Ratio
- Fly Ash Class and Percentage
- Ground Granulated Blast Furnace Slag Grade and Percentage
- All Materials from Approved Sources (AML)
- Cement Type
- Cement Alkalinity
- Admixture Type(s)
- MATT Codes
- Results of Trial Batches (required for ternary mixtures)
- Combined Aggregate Gradation for Types B and D

The mixture must demonstrate its workability and ability to consolidate under field conditions and be satisfactory to the engineer. The mixture must meet the specification requirements for slump, air, compressive strength, and when applicable, flexural strength and permeability. Failure of the mixture in any of these areas can result in cessation of production and rejection of the mix design.

MIX DESIGN FOR SPECIFIC DOTD PROJECT

When the concrete producer is to supply a mix for a specific project, the contractor or producer is to submit a pre-accepted mix design to the project engineer. The project engineer will check the mix design for conformance to specific contract requirements of correct class or type. If the mix design is appropriate for use on the project, the project engineer is to initial and date the form in the space below the "Date Received" field. The project engineer is to submit the initialed mix design to the district laboratory engineer. The district laboratory engineer will review the form and have it entered into the MATT System for that project. Mix designs for metric projects must be submitted in SI units. Mix design for English projects must be submitted in English units.

TRIAL MIXTURES

Trial mixtures are required to demonstrate the mix performance and material compatibility as

required in Section 901.06 of the *Standard Specifications*. The contractor shall produce trial mixes and submit test results for slump, air content, and compressive (flexural if required) strength at 3, 7 and 28 days and if required, permeability. The contractor shall furnish materials to DOTD for verification of trial mixes when requested.

SAMPLING AND TESTING FOR MIX DESIGN PURPOSES

All sampling and testing for the purposes of mix design are the responsibility of the contractor. However, at the contractor's request, certain tests (gradation, unit weight, specific gravity, and absorption factor of aggregate) will be performed by the Department. A chart providing specific gravities and absorption factors for naturally occurring Louisiana siliceous sands and siliceous gravel deposits is printed in the Appendix on page B-23. The *Approved Materials List* provides specific gravities and absorption factors for approved aggregate sources. Specific gravities and absorption factors for coarse and fine aggregates other than those listed in the chart must be determined by the Department.

DESIGN METHODOLOGY

The Absolute Volume Method of Mix Proportioning is the standard design method for DOTD projects and will be used to check the mix design for acceptance. The absolute volume is the volume of solid materials in the mixture, and it is computed from the material's mass and specific gravity. The sum of the absolute volume of all the components must add to one cubic yard (27.00 cubic feet) of concrete. The components used for this calculation may include cement and other cementitious materials such as fly ash, silica fume or ground granulated blast furnace slag, aggregates, water (not including the amounts absorbed by the aggregates), air, and any admixtures added to the mixture. The data required for the proportions calculation is listed in the next section.

PRELIMINARY DATA

To utilize this method of design, certain values must be known before the calculations can be completed.

- Specific Gravity at SSD Condition or Oven-Dry Condition and Absorption of Each Component
- Dry-rodded Unit Mass of Coarse Aggregate
- Maximum Size of Aggregate
- Fineness Modulus of the Fine Aggregate
- Specification Requirements for:
 - Maximum Water-Cement Ratio
 - Air Content
- Complete Gradations for Aggregates to be used in Type B and D Pavements.

SPECIFIC GRAVITY AND ABSORPTION OF EACH COMPONENT

The bulk specific gravity (SSD) of the aggregates is used to convert the calculated volumes of the components into batch weights. The specific gravity is the ratio of the weight of a substance relative to the weight of water. The bulk specific gravities are determined from AASHTO test methods T84 and T85 for fine and coarse aggregate respectively. These values have been determined for the approved aggregate sources and are provided in the *Approved Materials List*. However, it is recommended that the values are verified prior the calculation of mixture proportions. The specific gravity values are unitless and the same number can be used in either U.S. or SI units.

The specific gravity of portland cement ranges from 3.10 to 3.25. Usually a value of 3.15 is assumed for volumetric calculations of portland cement concrete mixtures. This means that a cubic foot of cement weighs 3.15 times more than a cubic foot of water. Portland cement blends such as portland blast-furnace slag and portland-pozzolan cements have specific gravity values ranging from 2.90 to 3.15. The specific gravity values for approved sources of fly ash and ground

granulated blast-furnace slag are shown in *Approved Materials List*. The value for the specific gravity of water is 1.00.

The aggregates are made up of solid matter and voids. These voids may absorb water and vary the mass of an aggregate depending on its moisture condition. The absorption values are used to calculate the change in mass of an aggregate due to the water it absorbs. AASHTO test methods T84 and T85 are used to determine the absorption values of fine and coarse aggregate respectively. The *Approved Materials List* provides absorption values for approved aggregate sources. Note A-4 in the *Approved Materials List for Aggregate* presents a relationship between the specific gravity at SSD condition and the water absorption factors for Louisiana silica sands and chert gravels. This table is also presented in Appendix B-23 in this manual. The absorption values are usually expressed as a percentage.

Any mix components that require sampling and testing for specific gravity or absorption, must be submitted to the Materials and Testing Section. Under normal conditions, the Department requires approximately ten days to complete testing and to transmit the results to the contractor.

DRY-RODDED UNIT MASS OR WEIGHT

This value will be calculated in accordance with AASHTO Designation: T 19 and it can be supplied by the district laboratory upon request by the contractor.

MAXIMUM SIZE OF AGGREGATE

Maximum size of aggregate is defined as the largest size of aggregate determined by gradation analysis. It will be determined by the contractor's personnel from the gradation of the actual stockpile of materials by the DOTD TR 113.

FINENESS MODULUS OF FINE AGGREGATE

The fineness modulus is an index of the fineness or coarseness of an aggregate. A higher fineness modulus indicates a coarser aggregate, for example, fine sand can have a fineness modulus of about 2.50 and coarse sand can be around 2.90. The fineness modulus is useful in estimating proportions of fine and coarse aggregate in a concrete mix. The fineness modulus will be the same in both U.S. and SI units.

The fineness modulus is calculated by the sum of the cumulative percentages retained on specific sieves and dividing it by 100. The specified sieves for the calculation of the fineness modulus of a fine aggregate are: 3/8 in (9.5 mm), No. 4 (4.75 mm), No. 8 (2.36 mm), No. 16 (1.18 mm), No. 30 (0.600 mm), No. 50 (0.300 mm), and No. 100 (0.150 mm). The complete set of sieves used to calculate the fineness modulus of coarser aggregate is specified in AASHTO Test Method T27. An example of a Fineness Modulus calculation is located in Appendix A on page A-3 and A-4.

CEMENT CONTENT

Cement contents shall be chosen to provide concrete with acceptable slump, air content, strength, and when required permeability as shown in Table 901-3 of the *Standard Specifications*.

WATER-CEMENT RATIO

The water-cement ratio is the ratio of mass of water to mass of cement used in the concrete mixture. The maximum water-cement ratios allowed by DOTD are listed in the *Standard Specifications* in Table 901-3 Master Proportion Table. Less water than the maximum allowed can be used as long as the mixture is acceptable to the Department.

AIR CONTENT FOR THE MIXTURE

For mix design approval, design each submitted concrete mix design at 5% air content. Each mixture shall contain air entraining agent in sufficient quantity to meet the air content range allowed in Table 901-3 of the *Standard Specifications*.

MIX PROPORTION CALCULATION

An example design of a Class A mix using the required air entrainment and water reducing admixture is given in Appendix A beginning on page A-5. The example utilizes the absolute volume method for proportioning concrete mixtures.

The maximum water-cement ratio and the total air are determined from the Master Proportion Table of the *Standard Specifications* (Table 901-3). The maximum aggregate size is to be determined by a gradation analysis from the stockpile. Note that the quantities for all of the components to be included in the mix are listed with the exception of the coarse and fine aggregate. These quantities must be determined to complete the design of the mixture.

DETERMINATION OF MIX PROPORTION OF COARSE AGGREGATE

The following table may be used to determine the volume of dry-rodded coarse aggregate required for one cubic yard of concrete. This is Table 901.1 in the *Standard Specifications*. The values for the fineness modulus of the fine aggregate and the maximum coarse aggregate size must be known in order to use this table. Interpolation might be necessary when the fineness modulus of the fine aggregate falls between the values of the table.

Table 1 - Volume of Coarse Aggregate Per Unit of Volume of Concrete

Maximum Size of Aggregate, in. (mm)		Volume of Dry-rodded Coarse Aggregate Per Unit Volume of Concrete for Different Fineness Modulus of Fine Aggregate				
		2.20	2.40	2.60	2.80	3.00
3/8	(9.5)	0.52	0.50	0.48	0.46	0.44
1/2	(12.5)	0.61	0.59	0.57	0.55	0.53
3/4	(19.0)	0.68	0.66	0.64	0.62	0.60
1	(25.0)	0.73	0.71	0.69	0.67	0.65
1 1/2	(37.5)	0.77	0.75	0.73	0.71	0.69
2	(50.0)	0.80	0.78	0.76	0.74	0.72
3	(75.0)	0.84	0.82	0.8	0.78	0.76

MOISTURE ADJUSTMENTS

Moisture adjustments are necessary when the aggregates are not at the SSD condition. An example of a moisture adjustment calculation can be found in the Appendix starting on page A-34. Adjustments can also be made using the *Portland Cement Concrete Plant Report: DOTD 03-22-4040* form. This form is shown on page B-25.

FLY ASH AS PARTIAL REPLACEMENT OF PORTLAND CEMENT

An example of a Class A mix design with fly ash as a partial replacement of portland cement is shown beginning in Appendix A on page A-13. The specifications allow for fly ash to be a pound for pound replacement up to 30% of portland cement.

GROUND GRANULATED BLAST-FURNACE SLAG (GGBFS) AS PARTIAL REPLACEMENT OF PORTLAND CEMENT

An example of the design of a Class A mix using a ground granulated blast-furnace slag (GGBFS) as partial replacement of portland cement with air entrainment and water reducing admixtures is located in Appendix A, beginning on page A-21. The specification for this mixture allows the use of ground granulated blast-furnace slag (GGBFS) as pound for pound substitution of cement up to 50% GGBFS by weight of cement.

TERNARY MIXTURES

An example of a Class A mix design using a combination of ground granulated blast-furnace slag (GGBFS) and fly ash as pound for pound substitution of portland cement is located in Appendix A, beginning on page A-25. The specification for this mixture allows combinations of ground granulated blast-furnace slag (GGBFS) and fly ash as pound for pound substitution of cement up to 70% by weight of cement.

PLAIN PORTLAND CEMENT TYPE B MIX

An example of a Type B mix design using air entrainment and water reducing admixtures is located in Appendix A, beginning on page A-29. As in previous examples, the example utilizes the absolute volume method for proportioning concrete mixtures, but in comparison with other examples, a third aggregate is required to meet the specifications.

CALCULATING BATCH WEIGHTS FROM MIX DESIGN PROPORTIONS

The proportions calculated for design purposes must be modified, for actual production, into batch weights based on the amount of total water in the fine and coarse aggregate determined by DOTD Designation: TR 106. These adjustments must be performed at least once per day prior to starting operations to account for changes in free moisture in the aggregate stockpiles. An example for determining the free moisture in aggregates begins on page A-41 of the appendix. Determining the corrected batch weights is demonstrated in Appendix A, beginning on page A-44.

CHAPTER 5 - PLANT OPERATIONS

RESPONSIBILITIES OF CONTRACTOR'S CERTIFIED TECHNICIAN

The portland cement concrete specifications place the responsibility for the purchase of materials, the design, and production of the mixture, and the transportation and final placement of the mixture on the contractor within the guidelines of the specifications and the direction of the engineer. **Therefore, the contractor's certified concrete technician is responsible for quality control.** Quality control is defined as the constant monitoring of equipment, materials, and processes to ensure that portland cement concrete mixtures produced and placed are uniform, within control limits, and meet all requirements of Section 901, as well as all other requirements of the *Standard Specifications*. The details of the certified concrete technician's responsibilities for quality control are covered under the **SAMPLING, TESTING, AND DOCUMENTATION** section of this chapter.

The contractor's certified concrete technician must:

- Be at the plant or project site whenever the plant is in operation. (When only minor structure concrete class concrete is being produced, the certified technician is not required.)
- Ensure that all materials to be incorporated into the mixture have been approved; that all certifications, test reports and other required documentation are available; and must run gradation and moisture content tests of the aggregate stockpiles.
- Be responsible for sampling and testing for control, including determining moisture contents and adjusting batch weights, setting all metering devices and scales, and ensuring that the plant is operating satisfactorily.
- Monitor the reception of materials and mix production in such a manner that all criteria established by the mix design and the *Standard Specifications* are met.
- Observe the trucks, their condition, and the loading operation to eliminate problems in the area of transport and mixing

- Be certain, prior to beginning any concrete operations for DOTD, that all scales and metering devices are functioning properly and have been properly calibrated and certified, in accordance with Department policies. For Department policies regarding the certification of scales and metering devices, refer to page 12.

The contractor's certified technician must check all scales prior to beginning batching operations and frequently during construction activity to ensure that scales zero. The technician must be certain that the batch weights for all components are clearly marked on the scales (dial) or as otherwise indicated (digital).

The certified technician shall determine the number of revolutions at mixing speed that the concrete will be mixed at the plant. The number must be chosen so that the specification limits will not be exceeded. The number of revolutions at the plant shall be documented on the *Batch Certification for Portland Cement Concrete: 03-22-4028*. An example of this form is shown on page B-27 in the Appendix. When complete mixing (minimum 50 seconds) is accomplished at a central mix plant, additional mixing at mixing speed will not be required during transport. If the concrete is partially mixed at a central mix plant, the mixture must be mixed a minimum of thirty seconds at the stationary mixer. It shall then be mixed between 20-30 revolutions at mixing speed in the truck transport.

RESPONSIBILITIES OF CONTRACTOR'S AUTHORIZED FIELD TESTER

An Authorized Concrete Field Tester will be allowed to perform the following QC procedures:

- slump
- cylinders
- air content
- unit weight
- temperature
- water additions

SAMPLING, TESTING, AND DOCUMENTATION

The *Materials Sampling Manual* establishes the minimum acceptable sampling and testing frequencies for projects using portland cement concrete. When test results or conditions require adjustments, additional tests or samples may be required to verify that the corrections adjust the mixture to meet specification requirements.

CEMENT

The contractor's certified technician is responsible for ensuring that every transport of cement is from an approved source and is accompanied by a *Cement Certificate of Compliance*. Approved sources of portland cement and portland-pozzolan cement are listed on the Department's *Approved Materials List*.

The certified technician shall ensure that the right type of cement is being used in the mixture and that cements of different types or sources are not mixed. The certified technician shall check the alkali content of the cement on the *Cement Certification of Compliance*. Reactive aggregates (as noted in the *Approved Materials List*, Approved Source-AML) shall not be used with cementitious materials which have an alkali content greater than specified.

FLY ASH, GROUND GRANULATED BLAST FURNACE SLAG (SLAG) & BLENDED CEMENTS (1P & 1S)

When fly ash or slag is to be incorporated into the mixture, the contractor is responsible for ensuring that every transport of fly ash or slag is from an approved source and is accompanied by a *Fly Ash or Slag Certificate of Compliance*. Copies of the Department's *Fly Ash Certificate of Compliance: 03-22-0023*, *Ground Granulated Blast Furnace Slag Certificate of Compliance: 03-22-0032* are reprinted in the Appendix on pages B-29 and B31. If blended cement is used, see a copy of *Certificate of Compliance for Portland Cement, Portland-Pozzolan Cement and Portland Blast-Furnace Slag Cement* on page B-33. Approved sources for these materials can be found in the Department's *Approved Materials List*, Approved Source (Qualified Products List). The certified technician shall also ensure that the right type of fly ash (C or F) and grade of slag (100 or 120) is being used as specified in the contract. The certified technician shall use the *Certificate of Compliance* to verify the fly ash is an Approved Material, and complies with AASHTO M 295 for Class C or Class F. Reactive aggregates shall not be used when total alkali content, calculated in accordance with DOTD TR 531, exceeds 2.5 percent by weight (mass). The alkali content is listed in the SiteManager Materials (SMM) system.

ADMIXTURES

When an admixture is incorporated into the mixture, the contractor is responsible for ensuring that every shipment of the admixture is from an approved source and is accompanied by an *Admixture Certificate of Compliance*. A copy of the Department's *Admixture Certificate of Compliance* is reprinted in the Appendix on page B-39. Approved sources of admixture are listed in the Department's *Approved Materials List, Approved Source*. If the shipment does not have a *Certificate of Compliance*, the certified technician shall notify the project engineer and request that a sample be taken and submitted for testing. It will take approximately 10 days to receive test results. **Any admixture that has not been approved shall not be used in concrete for DOTD projects.** Admixtures not listed in the *Approved Materials List, Approved Source (Qualified Products List)* shall be trial batched to demonstrate their intended specific use and comply with all of the requirements of Section 901. Results shall be submitted to the engineer.

If ambient air temperatures are such that an admixture may have been exposed to freezing temperatures, the material must be remixed, resampled, retested, and approved prior to use.

AGGREGATE

Gradation

As a requirement of the *Standard Specifications*, the certified concrete technician shall test both fine and coarse aggregates to determine gradation, which includes the amount of material passing the No. 200 (75 μ m) sieve by washing, according to the following schedule. These tests shall be documented on an *Aggregate Test Report* form (DOTD 03-22-0749). This form shall be made available to the Department on a daily basis. A copy of this form is shown on pages B-43 and B-44.

Fine Aggregate

The gradation of fine aggregate shall be routinely determined by dry sieving (DOTD Designation: TR 113) except when:

- The percent passing the No. 200 (75 µm) sieve by dry sieving technique exceeds two percent.
- The district laboratory acceptance sample indicates excessive minus No. 200 (75 µm) material. Should this situation occur, the samples shall be washed until the problem has been resolved.

When excessive minus No. 200 (75 µm) material is encountered and gradation samples must be tested by washing, a minimum of one sample per day shall be run in order to monitor and control stockpile conditions.

Coarse Aggregate

The gradation of coarse aggregate shall be routinely determined by dry sieving (DOTD Designation: TR 113) except when:

For Dedicated Stockpiles

If visual inspection indicates that contamination is occurring in a dedicated stockpile, the certified technician shall be required to determine the percent of material passing the No. 200 (75 µm) sieve by wash on each sample until the problem has been resolved to the satisfaction of the engineer.

For Nondedicated Stockpiles

STRUCTURAL OPERATIONS

The minus No. 200 (75 µm) wash shall not be run during routine gradation tests conducted by the certified technician, unless required by the engineer from visual inspection of the stockpile or the failure of the percentage of minus No. 200 (75 µm) material during testing of the independent fifth lot sample by the district laboratory.

PAVING OPERATIONS

The aggregates shall be checked visually each day for contamination and clay coating. If any sample tested by the district laboratory indicates more than 5 percent passing the No. 200 (75 μ m) sieve, the certified technician will be required to run the minus No. 200 (75 μ m) wash until the problem is resolved to the satisfaction of the engineer. The engineer may require that additional minus No. 200 (75 μ m) wash testing be performed.

Aggregate Test Report: DOTD 03-22-0749

Each aggregate gradation for fine and coarse aggregates shall be documented on the *Aggregate Test Report* or approved equivalent form. It is the responsibility of the contractor to complete this form and make available upon request.

A reprint of the *Aggregate Test Report* for coarse and fine aggregates, is shown pages B-43 and B-44 in the Appendix.

Concrete Aggregate Control Charts: DOTD 03-22-5004

The information from the *Aggregate Test Report: 03-22-0749* will be used to complete the *Concrete Aggregate Control Charts*. These charts shall be completed each day by the contractor and shall be available at the plant for review by the Department's certified inspector or other Department personnel. The original of these charts will be provided to the project engineer for project records.

Test results shall be entered on the control charts after the completion of each test. These results shall be analyzed to ensure that the results are within specification tolerances, and to ascertain whether or not any trends in gradation have developed which may be detrimental to the mixture. If test results show the gradation to be outside of specification limits, no material shall be produced for DOTD projects using these materials.

A trend toward the outer limits of the specifications may be caused by a change in material source, stockpile segregation, poor handling techniques, and a naturally occurring change in gradation in the material from the supplier, etc. If the control charts show a trend toward the outside limits of the specifications, the contractor shall take action to ensure that materials used on DOTD projects will meet specifications on a continuous basis and in a uniform manner.

Examples of *Concrete Aggregate Control Charts* for coarse and fine aggregates are shown in the Appendix on page B-47.

Moisture Content of Fine and Coarse Aggregates

Moisture content of fine and coarse aggregates to be used in concrete shall be determined at the beginning of each day's operation. Additionally, moisture contents must be determined whenever a change in moisture content in stockpiled material is suspected. These changes may be the result of weather conditions, length of storage, vertical location within the stockpile, or other conditions which lead to non-uniform moisture content. Changes in moisture content can lead to slump control problems. Moisture contents of fine and coarse aggregate shall be determined in accordance with DOTD Designation: TR 106.

Moisture probes for fine aggregate moisture content determination may be used to control production and batch adjustments. Probes shall be periodically verified to provide an accuracy of 0.5 percent of the results determined by DOTD TR 106.

CONCRETE

Portland Cement Concrete Plant Report: DOTD 03-22-4040

The *Portland Cement Concrete Plant Report* is to be completed and signed by the contractor. A copy of a *Portland Cement Concrete Plant Report* is in the Appendix on page B-25. This form, in conjunction with the *Batch Certification for Portland Cement Concrete: 03-22-4028*, is designed to document portland cement concrete batching operations. A copy of the form shall be

completed at least once per day and when there are changes to the mix design or when batch weights must be adjusted to compensate for changes in the moisture content of the aggregate.

Design (SSD) batch weights and total batch weights for each size batch used for the project shall be calculated and shown on the *Portland Cement Concrete Plant Report*. Actual batch weights will be documented on the *Batch Certification: 03-22-4028* for each individual batch. This form is shown in the Appendix on page B-27.

The original of the *Portland Cement Concrete Plant Report* shall be provided to the DOTD certified inspector for inclusion in project records. The contractor may keep as many copies as needed for records.

Calculating Batch Weights from Mix Design Proportions

The proportions calculated for design purposes (example Appendix A) must be modified, for actual production, into batch weights based on the amount of total water in the fine and coarse aggregate determined by DOTD Designation: TR 106. These adjustments must be performed at least once per day prior to starting operations to account for changes in free moisture in the aggregate stockpiles. The *Portland Cement Concrete Plant Report: 03-22-4040* is provided by the Department for the certified technician to use for these computations. The completed form should be kept with the daily control charts for review by the Department.

The maximum allowable water for design purposes is the amount of water that may be used, not the amount of water that must be used. Only enough water to produce concrete within the correct slump range should actually be used; however, in the example beginning on A-40 of the Appendix, for convenience, calculations will be based on using maximum allowable water.

Hot Weather Adjustments

Whenever the internal temperature of the concrete reaches 85°F (30°C), hot weather concrete

limitations become effective as required by 901.11 in the *Standard Specifications*. The contractor has the option to trial batch a proposed hot weather mix as per 901.11, which must be approved by the district lab engineer. Any mix not meeting the hot weather requirements of the 901.11 trial batch criteria must adhere to the following.

Concrete production shall be controlled to ensure that the internal temperature of the plastic concrete does not exceed 90°F (32°C) throughout placement. The addition of ice to the batch is one method of controlling the temperature of the concrete. Whenever ice is added to a batch of concrete, the amount of mixing water must be reduced by a comparable quantity of ice converted to gallons. The following conventional rule can be used to determine the amount of ice to be added in order to lower the temperature. For each degree °F reduction, add approximately 5 pounds of ice per cubic yard of concrete.

Cold Weather Adjustments

Do not place concrete when the internal temperature of the concrete is below 45°F (7°C) nor on frozen subgrade or into forms that are below 32°F (0°C). Concrete used in precast/prestress structural elements and drilled shafts may be exempt from the following temperature limitations at the determination of the Construction Fabrication Engineer. Differential temperature requirements for placement of mass concrete (MASS) will be affected by cold weather.

PC Mixes: Discontinue concrete operations when a descending air temperature at the jobsite, in the shade, and away from artificial heat, reaches 35°F (2°C) or NOAA forecasts the temperature to be less than 32°F (0°C) within the 24-hour period following placement. Do not resume PC concrete operations until an ascending air temperature at the jobsite, in the shade, and away from artificial heat, reaches 32°F (0°C); provided the high temperature forecasted by NOAA is above 35°F (2°C) and remains above 32°F (0°C) for a minimum of 24 hours.

Binary Mixes: Discontinue concrete operations when a descending air temperature at the jobsite, in the shade, and away from artificial heat, reaches 40°F (4°C) or NOAA forecasts the temperature to be less than 35°F (2°C) within the 36-hour period following placement. Do not resume concrete

operations until an ascending air temperature at the jobsite, in the shade, and away from artificial heat, reaches 40°F (4°C); provided the high temperature forecasted by NOAA is above 45°F (7°C) and remains above 40°F (4°C) for a minimum of 36 hours.

Ternary Mixes: Discontinue concrete operations when a descending air temperature at the jobsite, in the shade, and away from artificial heat, reaches 45°F (7°C) or NOAA forecasts the temperature to be less than 40°F (4°C) within the 48-hour period following placement. Do not resume concrete operations until an ascending air temperature at the jobsite, in the shade, and away from artificial heat, reaches 45°F (7°C); provided the high temperature forecasted by NOAA is above 50°F (10°C) and remains above 45°F (7°C) for a minimum of 48 hours.

Authorization from the Chief Construction Engineer is required for all concrete operations outside these cold weather limitations. When concrete placement is authorized at lower air temperatures, aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be so arranged as to prevent occurrence of overheated areas.

Batch Certification for Portland Cement Concrete: DOTD 03-22-4028

The batcher must complete the *Batch Certification for Portland Cement Concrete*. One copy of this form must be completed for each truck. The batch information required by the specifications can be provided by an automatic printer system, can be entered manually on the form, or by a combination of the two methods. If the information, or any part thereof, required by the batch certification form is supplied by an automatic printer system, the print-out generated by that system shall be attached to *Form 03-22-4028* for documentation purposes and for the convenience of the Department's certified inspector. An example of a *Batch Certification* is included in the Appendix on page B-27.

Control Charts for Slump And Air Of Concrete: DOTD 03-22-5003

The results of the contractor's control tests for slump and air during concrete placement will be recorded on this form (Appendix pages B-49 and B-50). The form may be completed by the concrete field tester, but it must be signed by the certified technician. Refer to page 43, **PAVING OPERATIONS**, and page 73, **STRUCTURAL OPERATIONS**.

Adjustments to the slump can be made prior to placement or in successive batches in order to meet specification requirements, or for workability within the specification ranges.

For adjustments to the slump, water may be added to a batch at the jobsite at a maximum of two increments. A range of 20-30 revolutions at mixing speed is allowed for each increment. Specifications require a minimum of 70 revolutions at mixing speed prior to any job site adjustments for each batch, up to a maximum of 300 total revolutions.

RESPONSIBILITIES OF DOTD'S CERTIFIED INSPECTOR

DOTD's inspector in charge of concrete operations must be certified in the area of construction activity (structural or pavement). For information on the certification process, refer to pages 15-16

MIX DESIGN REVIEW

When the contractor submits an **accepted** mix design for project use, the project engineer shall review the mix design for applicability to the project. The purpose of this review is to ascertain that the design is for the type or class mix specified by the plans or contract. The project engineer may delegate this responsibility to the DOTD Certified Inspector.

PRELIMINARY PLANT INSPECTION FOR PROJECT

Prior to the beginning of construction operations using portland cement concrete, the inspector must check the plans and contract for class(es) or type(s) of concrete to be used on the project and any special conditions or requirements of the mixture (e.g., Mass concrete, slip-form

operations, high performance concrete (HPC), weather limitations, etc.). The certified inspector shall determine the source of concrete from the contractor and shall coordinate the proposals made by the contractor with the conditions and requirements of the contract and plans. The inspector shall then arrange a preliminary inspection of the plant from which the contractor intends to supply concrete. In order to allow adequate time for any deficiencies to be corrected, this preliminary inspection should take place as far in advance of concrete operations as possible.

During this preliminary inspection, the certified inspector shall ascertain that the plant has a valid DOTD certification and that it has been maintained in accordance with the conditions under which certification was granted. If the plant is not certified, the certified inspector must notify the district laboratory engineer. Certification must be obtained before any concrete will be accepted from the plant. **The certified inspector must be certain that all scales and metering devices have valid calibration stickers, that scales zero and are operating properly, that the production required by the specifications can be met, and that the plant has access to an adequate number of certified trucks.** The trucks must also be inspected to be certain they have been maintained in accordance with the conditions under which certification was granted. When inspecting trucks, special attention should be paid on the revolution counter, the water measurement scale and concrete build up on blades.

The *Portland Cement Concrete Plant Certification Report: 03-22-4030*, and the *Portland Cement Concrete Truck Certification Report: 03-22-4045* will be a valuable guide to the inspector during the preliminary inspection of a certified plant or truck to ensure that the plant or truck still meets all requirements of certification. The inspector should check the plant or truck for each area of the form. The *Portland Cement Concrete Plant Certification Report* is reprinted in the Appendix on pages B-5 through B-14 and the *Portland Cement Concrete Truck Certification Report* on pages B-17 through B-20.

Prior to the beginning of concrete operations, the certified inspector shall ascertain that the contractor has all documents required by the Department available at the plant and that the technician is capable of properly completing the following forms:

- *03-22-5003 Control Charts for Air and Slump of Concrete*
- *03-22-5004 Concrete Aggregate Control Charts*
- *03-22-4040 Portland Cement Concrete Plant Report*
- *03-22-4028 Batch Certification for Portland Cement Concrete*
- *03-22-0745 Aggregate Test Report*
- *03-22-0735 Portland Cement Concrete Mix Design*

Examples of each form are shown in the Appendix.

MATERIALS INSPECTION

As part of the preliminary plant inspection, the inspector must determine the types and sources of all components to be used in project mixtures. All materials must come from approved sources. If it is determined from the plans or contract that unusual material conditions exist, the inspector must arrange with the contractor to obtain independent Department samples for submittal to the appropriate laboratory at least forty-five days prior to planned use.

Aggregate Sampling and Testing

Independent stockpile samples will be obtained by Department personnel and will be tested for gradation and foreign matter by the district laboratory for acceptance. Portions of the contractor's samples for quality control testing shall not be submitted to the district laboratory in lieu of the acceptance sample. The contractor is responsible for the quality control program of the plant. Acceptance sampling and testing for coarse and fine aggregates will be performed by the Department in accordance with the *Materials Sampling Manual*.

Dedicated or Nondedicated Stockpiles

The inspector shall determine if the contractor is planning to use dedicated stockpiles. The use of dedicated or nondedicated stockpiles will govern the schedule of gradation testing during routine operations. A dedicated stockpile is defined as a stockpile built for a specific project

contract. In common construction practice, dedicated stockpiles are found at central mix plants set up for PCCP projects.

The building of a dedicated stockpile must be approved by the project engineer. As the stockpile is being built, Department personnel will sample the material and submit the samples to the district laboratory for material acceptance testing. No additional sampling by the Department will be required for dedicated stockpiles, unless quality control results or visual inspection indicates contamination, segregation or other problems. This procedure allows the project engineer to authorize advance payments for the stockpiled materials in accordance with Subsection 109.07, *Standard Specifications*. The district laboratory will run a complete gradation on each sample, including the minus No. 200 (75 µm) material by wash. If the stockpiles used for concrete mixtures are not dedicated, Department personnel shall sample the stockpiles in accordance with the Material Sampling Manual and submit these samples to the district laboratory for gradation testing, including the minus No. 200 (75 µm) wash.

Paving Concrete

For paving concrete produced from **nondedicated** stockpiles, one full sample sack from each stockpile will be submitted for acceptance testing for each pavement lot. Project personnel shall obtain these samples during their plant visit and shall submit them to the district laboratory for testing. The samples taken shall be representative of the material incorporated into the mixture delivered for placement. These samples shall be delivered to the district laboratory in a timely manner. Test results shall be reported by the district laboratory to the project engineer as soon as possible after samples are submitted.

For paving concrete produced from **dedicated** stockpiles, one full sample sack will be obtained by Department personnel from each stockpile for each 1000 yd³ (1000 m³) of material delivered. Samples shall be obtained and tested during stockpile construction. Acceptance of this material during stockpile construction does not prohibit the Department from performing additional acceptance tests on the material during construction operations. The Department reserves the right to take additional samples and conduct additional tests to ensure that stockpile quality has

not deteriorated due to contamination, improper handling, etc. If subsequent testing is necessary and previously accepted material is no longer acceptable for use in DOTD projects, the guidelines provided **under Disposition of Failing Materials** shall apply.

Structural Concrete

For structural concrete produced from **nondedicated** stockpiles, one full sample sack from each stockpile will be sampled and submitted by Department personnel to the district laboratory for testing for gradation and foreign matter for acceptance testing every five days of production or 400 yd³ of aggregate. The samples taken by Department personnel shall be representative of the material incorporated into the mixture delivered for those project lots. These samples shall be delivered to the district laboratory in a timely manner. Test results shall be reported by the district laboratory to the project engineer as soon as possible after samples are submitted.

For structural concrete produced from **dedicated** stockpiles, one full sample sack will be obtained by Department personnel from each stockpile for each 1000 yd³ (1000 m³) of material delivered. Samples shall be obtained and tested during stockpile construction. Materials shall meet Department acceptance requirements prior to the issuance of authorization for partial payment. The contractor is responsible for maintaining the quality of the stockpiles in conformance with DOTD requirements after he has received payment. Acceptance of this material during stockpile construction does not prohibit the Department from performing additional acceptance tests on the material during construction operations. The Department reserves the right to take additional samples and conduct additional tests to ensure that stockpile quality has not deteriorated due to contamination, improper handling, etc. If subsequent testing is necessary and previously accepted material is no longer acceptable for use in DOTD projects, the guidelines provided under **Disposition of Failing Materials** shall apply.

DISPOSITION OF FAILING MATERIAL

Dedicated Stockpiles

Material represented by a failing sample shall not be added to a dedicated stockpile. All material shall be sampled, tested, and approved prior to being placed in a dedicated stockpile.

If a dedicated stockpile appears to have deteriorated in quality since initial acceptance, the Department will take additional samples to determine the current suitability of the material for use in DOTD projects and to establish the source of the deterioration. If tests indicate that the material no longer meets DOTD standards, the contractor shall be required to adjust his quality control operation (mixing, testing, handling, etc.) in order to correct the deficiencies prior to delivering additional concrete to DOTD.

If material represented by a failing sample has already been incorporated into a project, the Department will investigate the quality of the concrete in-place in order to determine its acceptability. The contractor may be required to remove any concrete produced and placed which incorporated unsatisfactory material. The Department will also investigate the contractor's quality control program, including testing equipment, sampling and testing methods used by the contractor and the credentials and capabilities of the certified technician. The contractor will be required to modify his program to correct all deficiencies prior to delivery and to ensure that unsatisfactory material will not be incorporated into subsequent lots. **If the contractor's quality control program does not ensure that materials produced will meet DOTD requirements, the plant's certification will be revoked.**

Nondedicated Stockpiles

If an acceptance sample from a nondedicated stockpile fails to meet Department specifications, the concrete plant will be required to cease operations for DOTD projects immediately. The stockpile shall be corrected, if possible, or all material represented by the failing sample removed. Following the correction of the stockpile or the removal of the material represented by the failing test result, the remaining stockpile material shall be resampled and tested at a frequency

determined by the district laboratory engineer. Sufficient samples shall be taken to ensure that all material remaining in the stockpile meets DOTD standards. Operations shall not recommence for DOTD projects until stockpile materials test satisfactorily.

If material represented by a failing test result has already been incorporated into a DOTD project, the Department will investigate the concrete in-place in order to determine its acceptability. The contractor may be required to remove any concrete produced and placed which incorporated unsatisfactory material. The Department will also investigate the contractor's quality control program. The contractor will be required to modify his program to correct all deficiencies and to ensure that unsatisfactory material will not be incorporated into subsequent lots. If the Department is not satisfied with the contractor's quality control process, the Department reserves the right to require the contractor to construct dedicated stockpiles for DOTD projects. **If the contractor's quality control program does not ensure that materials produced will meet DOTD requirements, the plant's certification will be revoked.**

The completed *Aggregate Test Report (DOTD Form No. 03-22-0745 or accepted electronic form)* shall be made available by the contractor to the Department on a daily basis, with the control charts for slump, air and gradation and the *Portland Cement Concrete Plant Report*. These documents shall be provided to the Department by the end of the project for inclusion in the plant records.

ACCEPTANCE/VERIFICATION SAMPLING AND TESTING

All acceptance and verification samples will be taken by Department personnel and delivered to the district laboratory. Test results will be reported by the district laboratory engineer to the project engineer as soon as possible after samples are received. Upon receipt of failing test results, the project engineer shall immediately report the disposition of that failing material to the district laboratory engineer. This disposition will be entered into SiteManager for subsequent inclusion in the 2059 Review.

INSPECTION DOCUMENTATION

The inspector shall note and document any deficiencies observed. The project engineer shall be notified immediately of the inspector's findings. All deficiencies must be corrected prior to the beginning of concrete activities.

PLANT INSPECTIONS

When concrete operations are in progress, the certified inspector should make every effort to visit the plant daily. During these plant visits, the inspector shall check the plant equipment to be certain that no malfunctions have occurred that would cause the plant's certification to be revoked or that might have a detrimental effect on the mixture. If any equipment failures have occurred, the certified inspector must require that they be repaired immediately. If the problem is serious enough to place the plant outside of certification standards, the inspector shall immediately notify the project engineer and the district laboratory engineer. As a part of this equipment inspection, the inspector shall ascertain that scales are returning to zero when empty, that they are weighing batches properly, that admixture metering systems are functioning properly, and that the batch weights marked on each scale are the correct ones for the mix design under production. The certified inspector should make every effort to examine mix materials on a regular basis. The inspector should check material sources and types and inspect stockpiles for segregation, contamination, drainage, etc. Any certificates for material shipments arriving during operations must be checked and placed in the project files. The certified inspector must also be certain that the contractor is performing all sampling and testing in accordance with Department requirements. The inspector should check the calculations correcting mix design for proportion requirements. **The inspector must be certain that the plant is producing concrete in accordance with the correct project mix design for the item being constructed. This is especially important when more than one design is approved for a specific project or when a plant is producing mixtures for more than one project.** The inspector shall examine the control charts for aggregate, slump, and air. If any trends are developing in the mixture that may cause the mixture to move outside of specification ranges or the concrete to develop low strengths, the inspector must be certain that the contractor is aware of these trends and that proper adjustments are made to prevent the mix from moving outside of specification limits. If the mix exceeds specification limits, the certified

inspector will reject the concrete and require that adjustments which bring the mix within the requirements of Section 901, *Standard Specifications*, be made prior to accepting additional concrete. **Finally, it is the responsibility of the certified inspector to coordinate the resolution of any problems encountered in construction activities or acceptance testing with the contractor.**

The Department's certified inspector will sign the *Portland Cement Concrete Plant Report: 03-22-4028*, the *Concrete Aggregate Control Charts: 03-22-5004* and the *Control Charts for Slump and Air of Concrete: 03-22-5003* after review. The inspector's signature or electronic signature indicates that the inspector has reviewed the information. If the inspector does not accept the information on the forms as completed, he or she shall explain any reservations, using the remarks field of the *PCC Plant Report*, and promptly inform the project engineer; however, the inspector will still sign the forms.

CHAPTER 6 - PAVING OPERATIONS

RESPONSIBILITIES OF CONTRACTOR'S PERSONNEL

In general, these requirements are applicable to both roadway and shoulder paving. **It is the responsibility of all personnel to check the contract and plans for specific requirements.**

BASE COURSE, FORMS, LOAD TRANSFER DEVICES, AND REINFORCEMENT

Prior to beginning concrete placement, the contractor must be certain that all formwork is in place and set to grade in conformance with Section 601, *Standard Specifications*. All corrections must be completed before final approval will be given by the Department's representative.

PAVING EQUIPMENT

The contractor shall submit the type of equipment to be used and the proposed method of construction to the project engineer for review at least 7 days prior to paving. This information is to be sufficiently detailed to permit a complete evaluation as to suitability and adequacy. If there are any concerns about the proposed equipment, headquarters' construction section may be contacted.

All equipment to be used in the paving operation must be available at the job site for inspection by Department personnel. The equipment must be inspected by the project engineer at least 24 hours in advance of the beginning of paving operations. Any deficiencies in the equipment must be corrected to the satisfaction of the engineer prior to the beginning of paving operations.

MATERIALS, PERSONNEL, AND TESTING EQUIPMENT

Materials to be used in paving operations, such as joint forming devices, joint fillers and seals, load transfer devices, curing materials, reinforcing steel, etc., shall be made available sufficiently in advance of paving to allow sampling, testing and approval prior to use. Under normal conditions, this process takes approximately ten working days for sampling, testing, and

approving materials. Sufficient time shall be allowed for testing to be completed. **Only materials which have been approved by the Department shall be used on the project.**

The contractor must be certain that a sufficient number of experienced personnel will be on site to ensure a smooth and efficient paving operation.

It shall be the responsibility of the contractor to provide a certified technician and all quality control testing equipment. The contractor must provide adequate equipment in satisfactory condition for the performance of all tests which may be required by the Department. The Department will inspect all testing equipment prior to its use. **No concrete shall be batched until the certified technician is present and all testing equipment has been approved.** When quality control testing is to be provided by an independent testing laboratory, it shall be the responsibility of the contractor to assure the Department that all the requirements discussed above will be met at any time that placement operations are scheduled.

WEATHER LIMITATIONS

Refer to Section 901, *Standard Specifications* for all weather related limitations.

PRE-POUR CONFERENCE

The contractor or a representative shall be required to attend any pre-pour conferences established by the project engineer. The contractor shall assure the Department that the certified technician, concrete supplier, and any contracting parties involved with the pour will attend pre-pour conferences as necessary.

SLUMP AND AIR TESTS

To establish control and to verify desired batch proportions, the contractor's certified technician or Authorized Field Tester shall test the first truckload every day for slump and air content. Slump and air must meet specification requirements prior to the placement of concrete. This procedure will provide the contractor with the opportunity to make any necessary adjustments without excessive waste of material. The results of these tests shall be recorded on the *Batch Certification* form for that truck load. For an example of a form, refer to the

Appendix, page B-25. If the slump or air tests indicate that adjustments to the mixture are necessary, these adjustments shall be performed at the plant immediately. The adjustments shall be recorded on the *Batch Certification* form for the appropriate batches.

If the slump test on the first truckload indicates that the batch is out of specification requirements, on the low side, and it is possible to adjust the batch to bring it into specification range by addition of allowable water or use of a water reducer, such adjustments will be allowed. The *Standard Specifications* allow water to be added to truck mixers at the job site only in a maximum of two increments. **Water shall not be added to a partially placed load.** However, under no circumstances will the maximum water-cement ratio, number of allowable revolutions, or the applicable specification time limit be exceeded. **If such adjustments are not possible, the batch shall be rejected and no concrete shall be accepted until appropriate plant adjustments are made. Furthermore, if the mix is obviously deficient by visual observation, it shall be rejected prior to placement. These guidelines and procedures shall be followed for subsequent trucks until the desirable mix is being produced.**

In addition to the tests, which shall be performed on the first truckload of mix, the Contractor's Certified Technician or Authorized Field Tester shall perform a minimum of two slump and two air tests per each half day of operations. These tests shall be performed in accordance with DOTD Designations: TR 207 and TR 202. Samples for these tests shall be obtained in accordance with DOTD Designation: S 301.

The results of these tests shall be entered on the *Batch Certification* and plotted on the *Control Charts for Slump and Air of Concrete: 03-22-5003*, a reprint of is on pages B-49 and B-50 in the Appendix. The certified technician shall review these charts to determine any trends developing in the mixture. If it appears that the mixture is moving toward the outer parameters of the specifications, the technician shall make appropriate adjustments at the plant to ensure that the mixture stays within the parameters of the specifications. If the mixture does move outside the parameters of the specifications, the batch will be rejected and no material will be accepted until adequate adjustments have been made.

Control charts must be maintained on a daily basis and be available for review by Department personnel. The original control charts must be provide to Department personnel for project files

and be included in the 2059 Review. If the control tests for slump or air are performed by the authorized concrete field tester, the tester may enter the results on the *Batch Certification* form and the control charts; however, both documents must still be signed by the contractor's certified technician who is ultimately responsible for quality control of the project. The contractor may keep copies for his own files.

PLACEMENT OPERATIONS

Once the base course, forms, load transfer devices, reinforcement, materials, and equipment have met Department requirements, the contractor can schedule placement operations.

The surface on which the concrete is to be placed shall be uniformly moistened by sprinkling immediately prior to concrete placement. The method and amount of sprinkling shall not be such as to form mud or pools of water.

Concrete shall be deposited on the grade so that as little rehandling as possible is required. Equipment shall be designed and operated as to assure placement and spreading of concrete without segregation. Placement shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels or other approved tools, excluding toothed rakes. Untoothed concrete rakes may be used. When concrete must be placed by shovel, the shovel should be used to drag the concrete into place. Do not lift the concrete or toss it with a shovel, as this can cause segregation. Do not walk in freshly mixed concrete with boots or shoes coated with earth or foreign substances. Dowel bar placement shall be accurately and securely marked to guarantee accurate sawing of the joints.

After the concrete has been placed, it shall be struck off to conform to the specified cross section and to an elevation such that when the concrete is properly consolidated and finished the pavement surface will be at plan elevation.

The placement of joint forming devices shall not cause excessive displacement of concrete. Only a minimum amount of handwork should be done around joints. The placement of excessive amounts of mortar to correct displaced concrete around joints will cause spalls and pavement failure. Joints must be straight, vertical, and correctly spaced. The longitudinal joint

must be continuous. All reinforcing at joints must be clean and properly aligned, spaced, and placed at the proper depth. Bars must be of the correct type, diameter, and length.

After the surface of the concrete has been floated and any excess bleed water or laitance has been removed, the surface of the plastic concrete shall be tested for trueness with a ten-foot static straightedge, furnished, and operated by contractor personnel, in accordance with Subsection 601.03.9.5, *Standard Specifications*.

Water shall not be added to concrete which has attained its initial set, in order to retemper the mixture. Concrete which reaches its initial set prior to finishing operations shall be removed. Initial set is the early strengthening of concrete due to chemical reaction between the water and the cement. Initial set is generally recognized by the Department as occurring when the penetration resistance measured by a penetrometer reaches 500 psi (3440 kPa).

Final finish and texture shall be obtained in accordance with Subsections 601.03.9.7 and 601.03.9.8, *Standard Specifications*. The contractor's personnel shall test the fresh concrete for tines and texture in accordance with DOTD TR 229. The texturing operation shall meet the satisfaction of the engineer. Problems in achieving the desired texture depth stem primarily from two sources: poor control of concrete consistency or texturing the pavement at the wrong time as a result of negligence or poor judgment. Tine size and spacing are crucial in minimizing noise generated by the traffic. It is imperative that the size and spacing requirements of 601.03.9.8 of the *Standard Specifications* be met.

Immediately after completion of finishing operations, apply a white pigmented impervious membrane to all exposed surfaces of newly placed concrete. The rate of application shall be in accordance with the manufacturer's recommendations. It shall be a minimum of one gallon per 100 square feet (4 liters per 10 square meters). Concrete shall not be left exposed for more than one-half hour before the curing membrane is applied. Curing shall be maintained continuously for 72 hours. After application of curing compound, resulting pavement surfaces shall have a uniform appearance of a "blank sheet of paper". Immediately reapply additional compound to all deficient areas during the curing period.

The contractor shall have available at the job site sufficient covering material to properly protect

any concrete which has not reached initial set from the effects of rain. Covering material may be burlap mats, waterproof paper, or burlene type sheeting. Failure to provide sufficient cover material, or adequately take care of curing, may be cause for immediate suspension of concrete operations.

It shall be the responsibility of the contractor to maintain control of yield. Unit weight tests and calculations shall be performed by the certified technician, as needed, in accordance with DOTD Designation: TR 201.

The contractor is responsible for ensuring that the finished pavement, including shoulders, will meet the surface finish requirements of Subsection 601.03.9.7, *Standard Specifications*. The contractor shall furnish an approved profiler for testing of pavement smoothness and an approved ten-foot static straightedge for shoulder testing, in accordance with Subsection 601.03.11. The contractor shall maintain the straightedge in acceptable condition during use.

The accurate sawing and sealing of joints in portland cement concrete pavement is the responsibility of the contractor. Each joint will be subject to inspection and approval by Department personnel before sealing is allowed. Joints must be of proper width, depth, alignment and be properly prepared for sealing. For requirements of specific types of joint sealants, refer to Subsection 601.03.8, *Standard Specifications*.

The contractor shall protect the pavement against both public traffic and traffic caused by his own employees and agents. This shall include providing traffic control and the erection and maintenance of warning signs, lights, pavement bridges or crossovers, etc., as necessary to ensure the work zone. Any damage to pavement which occurs prior to final acceptance shall be repaired or the pavement replaced.

It is the intent of the specifications that the contractor identifies any deficiencies in operations and makes corrections. It is not the intent that the Department has to discover continuing deficiencies during acceptance testing.

SAWING - LONGITUDINAL AND TRANSVERSE JOINTS

It is critical that joints be accurately and securely laid out, sawed at the proper time, and to the proper depth and width. **Sawing shall not be delayed.** Weather conditions, admixtures, and additives (e.g. fly ash & slag), as well as many other factors, can affect the curing of the concrete, and must be considered in determining the time to saw. Joints shall be formed in accordance with Subsection 601.03.8.8, of the *Standard Specifications*. Sawing operations that occur before proper curing may lead to raveling and random cracking may occur if the sawing operations are delayed.

DAILY MONITORING FOR PROJECT CONTROL

Daily operations shall be monitored by the contractor for conformance to the specifications in all aspects. The quality of the product shall be checked behind the paver and shall include the following:

- thickness, grade and surface tolerance of plastic concrete
- joint placement (longitudinal and transverse)
- surface finish
- tine texture
- curing compound
- longitudinal surface tolerance
- joint sawing
- placement of joint sealers

These evaluations shall be used by the contractor for the purpose of control in order to ensure that continuing operations will meet all requirements of the specification. Additionally, the contractor is responsible for maintaining records of all batching operations conducted for DOTD projects:

- *Portland Cement Concrete Plant Report: DOTD 03-22-4040*
- *Aggregate for PCC Pavements (Types B & D): DOTD 03-22-0749*

- *Batch Certification for Portland Cement Concrete: DOTD 03-22-4028*
- *Aggregate Test Report: DOTD 03-22-0745*
- *Concrete Aggregate Control Charts: DOTD 03-22-5004*
- *Control Charts for Air and Slump of Concrete: DOTD 03-22-5003*
- *Certificate(s) of Compliance for Cement, Fly Ash, Admixtures, and Curing Compound*

The project engineer shall be provided with a signed copy of all batch records represented by the forms listed above, plus the *Certificate(s) of Compliance* for each shipment delivered to the plant. Prior to beginning batching operations, sampling and testing for moisture content, gradation, and the calculation of batch weight adjustments shall be completed by the certified technician as outlined in the *Materials Sampling Manual*. Additional sampling and testing for gradation, moisture content, and calculations for batch weight adjustments are required when there are significant changes in the stockpiles.

RESPONSIBILITIES OF DOTD PERSONNEL

BASE COURSE, FORMS, LOAD TRANSFER DEVICES, AND REINFORCEMENT

The Department's certified inspector must check the forms and the surface of the base course to be certain that they meet all specification requirements and that they conform to the grade and alignment requirements of the plans. Forms shall be checked for alignment, rigidity, cleanliness, and proper application of the form release agent. The inspector shall check the staking pockets, key pin arrangement, and joint locking device on each form. Reinforcement and dowel bars shall be checked for alignment, proper station location, proper spacing across pavement, and correct elevation. Dowel bars must be properly plastic coated. Dowel bars with slightly damaged coatings may be used with the approval of the engineer provided the bars are lightly oiled or greased prior to placement. As an option, the contractor may have appropriate dowel basket restraining wires removed prior to placement of concrete. The contractor will supply the project engineer an approved method describing how the dowel bars will be accurately and securely marked in order to facilitate accurate sawing of the transverse contraction joints. When concrete is placed, tie bars must be free of oil, rust, mud or any other substance, which will interfere with the bond. If deficiencies are discovered, the inspector must

notify the contractor. All deficiencies must be corrected before any concrete can be placed. When PCCP is to be placed directly on unstabilized base, geotextile fabric must be placed on the base beneath the joint.

PAVING EQUIPMENT

The certified inspector should coordinate the inspection of paving equipment and process to be used on the project with the contractor. Trucks to be used for mixing and/or transporting concrete must be certified and must be in acceptable condition. Inspection of the equipment is the responsibility of the project engineer and the certified inspector. All equipment must meet the requirements of the *Standard Specifications* and must be capable of providing a finished product that is acceptable to the Department. Any equipment that does not pass inspection must be replaced or repaired before concrete operations can begin.

Equipment must be inspected continually during operation. If any equipment develops a malfunction that would be detrimental to the final product, the certified inspector shall require the contractor to discontinue paving operations until the equipment can be repaired or replaced.

MATERIALS

All materials to be used on the project, including such items as joint forming devices, joint fillers and seals, load transfer devices, curing materials, and reinforcing steel must be approved prior to the beginning of operations or use. The certified inspector must coordinate with the contractor should independent samples need to be obtained, tested, and approved prior to the planned beginning of operations. Materials which have not been tested and approved shall not be utilized in the construction of DOTD projects.

PLACEMENT OPERATIONS

The certified inspector shall observe the contractor's placement operation and ensure that the contractor complies with all requirements of the *Standard Specifications*. For further details regarding placement, handling, and finishing of concrete pavement, refer to previous section regarding placement operations for contractor's personnel.

The Department's certified inspector shall be certain that the contractor's certified technician or Authorized Field Tester performs slump and air tests on the first truckload of mixture delivered to the job site, prior to allowing concrete placement. **If the mixture is not in accordance with the requirements of Table 901-3, Section 901, *Standard Specifications*, no mixture is to be placed until appropriate adjustments have been made.** If the mixture is obviously deficient by visual observation, the certified inspector shall reject the batch.

TINE FINISH

The tine finish of the hardened concrete shall be checked daily by the Department's inspector in accordance with DOTD Designation: TR 229. The depth of the grooves shall be checked at five randomly selected locations spaced across the roadway. These five depth checks and their average shall be recorded twice per lot on the *Portland Cement Concrete Pavement Report: 03-22-4035*. (See Appendix pages B-49 and B-50)

JOINT SAWING AND SEALING

The DOTD certified inspector shall inspect and approve each joint prior to allowing the contractor to seal the joints. Joints shall be checked for proper preparation of width, depth, alignment, and cleanliness. Particular attention should be paid to the end of the cut on sawed joints. Joints must be reasonably free of spalls, fractures, breaks, or voids, and match with the marks indicating the joint location. Areas that must be repaired shall be chipped back to sound concrete and repaired with an approved non-shrinking patching system used in accordance with the manufacturer's recommendation.

Joints shall be thoroughly cleaned and dried immediately prior to sealing. When poured sealants are used, the joint faces shall be sandblasted immediately prior to sealing. Sandblasting is not required for preformed elastomeric compression seal except when the joint insert is sawed.

Sealant shall be placed as soon as possible after curing of concrete. When a liquid poured sealant meeting the requirements of Subsection 1005.02 is used, traffic shall not be permitted while sealing and until after the sealant has cured. Under no circumstances will traffic be

permitted for at least one day after sealing. When elastomeric compression seals are used, the pavement may be opened to traffic immediately following completion of sealing.

Joint sealant shall be installed in accordance with specifications and the manufacturer's recommendations. Sealant shall be installed to a depth of 1/4 to 3/8 in. (7mm to 10mm) below the pavement surface. The overstretching (greater than 5%) of elastomeric compression seals shall not be permitted. The certified inspector shall check each installation to be sure that these requirements are met. A copy of the Department's *Certificate of Delivery for Joint Sealants (03-22-0025)* is reprinted in the Appendix on page B-35.

DAILY INSPECTION

Daily operations will be evaluated by the certified inspector for conformance to the specifications. The quality of the product shall be checked behind the paver and shall include the following:

- thickness, grade and surface tolerance of fresh concrete
- joint placement (longitudinal and transverse)
- surface finish
- tine finish
- curing compound (proper rate and uniformity)
- theoretical and actual yield comparison
- joint sawing
- placement of joint sealants

The originals of all required Department forms must be obtained from the contractor for inclusion in the 2059 Review.

ACCEPTANCE TESTS

Slump and Air Content

The *Materials Sampling Manual* requires a minimum of one acceptance test per half day for slump and for air during concrete paving operations. These tests are to be performed in

accordance with TR 202 and TR 207. They must be performed under the direction of the Department's certified inspector or Department's authorized field tester from samples of material obtained independently in accordance with DOTD Designation: S 301. **The observance and documentation of the contractor's control testing operation shall not be substituted for acceptance testing.**

The results of the inspector's acceptance tests shall be recorded on the *Portland Cement Concrete Pavement Report: 03-22-4035*. An example of a *PCC Pavement Report* is printed in the Appendix on pages B-49 and B-50.

If acceptance test results are not within specification ranges, the batch of concrete represented by these tests shall be rejected. The contractor must be notified. The certified inspector shall require that adjustments be made to the mixture to bring future batches into specification ranges. When a mixture fails acceptance testing, additional tests shall be performed on subsequent batches. **Material which does not meet specification requirements shall not be incorporated into the project.**

The Department's certified inspector on the project shall be responsible for completing the section of the *Batch Certification* form labeled "For Department Use Only." If the information is entered by Department personnel who are not certified in the applicable construction activity, it must be reviewed by the certified inspector who must also sign the form. An example of a *Batch Certification for Portland Cement Concrete* is shown in the Appendix on page B-27.

THICKNESS AND COMPRESSIVE STRENGTH

PAVEMENTS AND SHOULDERS

Concrete pavement and shoulders are accepted based on the results of tests for thickness and compressive strength made on cores taken directly from the hardened in place concrete. These cores will be obtained by the contractor under the direction and in the presence of Department personnel. The contractor shall cut these cores, and the DOTD Representative shall take immediate possession of the cores. The cores will be tested by the Materials and Testing Section or District Laboratory. The Laboratory performing the testing will also determine the

applicability of any payment adjustment in terms of thickness and compressive strength based on Table 601-3 (Payment Adjustment Schedule), Section 601, *Standard Specifications*. It will be the responsibility of the project engineer to determine the final payment adjustment for the entire lot, based on thickness, compressive strength, and surface tolerance. This report shall be included in the 2059 Review.

The contractor shall notify the Department at least five days prior to the start of coring operations. Concrete must be at least fourteen days old or attained a 3,000 psi compressive strength before coring operations will be allowed. Lots, as identified on the approved Lot Layout for the project, must be clearly marked on the pavement surface prior to requesting that cores be taken..

The Department will divide each lot of concrete pavement and shoulders into five segments of approximately equal size; one core will be obtained from each segment in accordance with DOTD Designation: TR 225. Core locations will be determined by application of the Random Number Tables: DOTD Designation: S 605. A copy of the Department's *Drilled Paving Concrete Cores (03-22-0736)* is reprinted in the Appendix on pages B-53 and B-54.

Each core is measured at the time of coring by the Department's representative. This measurement will be recorded as a field measurement. Areas of pavement found deficient in thickness by more than 1/2 in. from specifications will be investigated for possible removal or 50% payment. The official thickness of each core will be determined at the Materials and Testing Section or District Laboratory in accordance with DOTD Designation: TR 225 (AASHTO T 148).

COMPRESSIVE STRENGTH CYLINDERS FOR EARLY OPENING OF CONCRETE PAVEMENT

If a roadway is to be opened to traffic before fourteen days have elapsed after placement, compressive strength cylinders shall be made when the concrete is placed. A sufficient number of cylinders shall be made, so that successive sets of three cylinders can be broken until such time as the cylinder breaks indicate that the concrete has reached the required 3,000 psi (20.7 MPa) compressive strength. Concrete for such cylinders shall be furnished by the contractor at his expense. Cylinders will be made and cured in accordance with DOTD Designation: TR 226.

They will be made by Department personnel under the direction of the Department's certified inspector and tested by the district laboratory.

The molding of early break concrete cylinders shall be recorded. The ID shall be coordinated with the Batch Certification form for the truck from which the cylinder concrete was obtained.

LONGITUDINAL SURFACE TOLERANCE

The longitudinal surface tolerance of portland cement concrete pavement travel lanes, associated pavements, shoulders, turnouts and crossovers shall conform to the requirements of Section 601.03.11.3.1 of the *Standard Specifications*.

Pavement travel lanes and associated pavements shall be tested for acceptance with an approved Inertial Profiler. Daily or periodic quality control checks should be made by the contractor prior to the final acceptance test. Areas not meeting the minimum International Roughness Index (IRI) requirements shall be corrected by the contractor in accordance with Section 601.03.11 of the *Standard Specifications*.

The longitudinal surface tolerance of the surface of shoulders, turnouts and crossovers shall be tested for acceptance with an approved minimum 10-foot (3.0m), metal, static straightedge. Areas not meeting the minimum requirements shall be corrected by the contractor in accordance with Section 601.03.11.3.2 of the *Standard Specifications*.

Results of surface tolerance and percent pay for surface tolerance are determined and entered by the district laboratory.

Refer to **SURFACE TOLERANCE TESTING** for detailed information on longitudinal surface tolerance testing for acceptance.

PORTLAND CEMENT CONCRETE PAVEMENT REPORT

The *Portland Cement Concrete Pavement Report: 03-22-4035 (B-49 and B-50)* shall be completed by the certified pavement inspector and approved by the project engineer for each lot of pavement on the project. This report shall be included in the 2059 Review.

Information regarding the location of miscellaneous type pours (intersections, turnouts, crossovers, etc.) will be difficult to enter on the form. The inspector is expected to exercise engineering judgment as to the pertinent information to be entered in such circumstances. The Remarks field should be used when additional clarification is necessary. In cases of multiple pour lots, the data from each pour will be entered on the *Portland Cement Concrete Pavement Report* and an interim logging report will be generated from this computer entry. Additional pours made on the lot will necessitate that project engineer's personnel accumulate data and update the computer file for the lot. Once the lot is complete, a final report will be generated. Additionally, the theoretical and actual yield of the concrete expressed as square yards per cubic yard or square meters per cubic meter are completed and entered on the report. The theoretical yield determines how much area a cubic yard or cubic meter of concrete *should* cover on a roadway based on plan width, plan thickness, and the length of the section to be paved. The actual yield tells you how much area was *actually* covered with the quantity of cubic yards or cubic meters of concrete used. If the actual yield is *less* than the theoretical yield, it may take *more* concrete than anticipated to complete the entire project if it continues consistently. If the actual yield is *greater* than theoretical yield, *less* concrete will be needed to complete the project if it continues consistently. Some factors that affect the actual yield are under and over thicknesses or widths, insufficient or excessive cross slope, deficiencies in the base course that affect grade and variations in the composition of the concrete during batching operations.

Examples of the calculations for theoretical and actual yield are located in Appendix A, beginning on A-47.

CHAPTER 7 - STRUCTURAL OPERATIONS

RESPONSIBILITIES OF CONTRACTOR'S PERSONNEL

FORMS AND REINFORCEMENT

Prior to the beginning of a concrete placement, the contractor must be certain that all falsework, formwork, and reinforcement are in place and meet the requirements of Sections 805 and 806 *Standard Specifications*. The contractor shall check the alignment and grade of all forms and be certain that any planned deflection under load (camber) has been taken into consideration in form placement. Forms must be cleared of all deleterious material prior to any concrete operations. Forms must be coated with an approved form release agent prior to the placement of reinforcing steel; no form release agent is to contact reinforcing steel. Reinforcing steel must be correctly aligned, spaced, tied and supported in accordance with the dimensions and elevations indicated on the plans. Reinforcing steel must be clean and of the proper size, length and configuration. Splices must be staggered and lapped to meet the requirements of Subsection 806.06, *Standard Specifications*. On deck pours, a dry run with the screed will be required as a part of this inspection. The contractor will be required to correct any deficiencies that are discovered during this inspection. All corrections must be completed before final approval will be given by the certified inspector.

PLACEMENT AND FINISHING EQUIPMENT

The contractor must have all equipment (including back-up equipment) to be used during placement operations on site prior to the beginning of any concrete pour. When concrete is to be placed by pumping, a back-up pump or an alternate system for concrete placement shall be available. All equipment must be available for inspection by Department personnel at or prior to the pre-pour conference. Any deficiencies that are noted during this inspection shall be corrected by the contractor or the equipment replaced with approved equipment prior to the beginning of pouring operations. **Equipment which has not been approved by the Department shall not**

be used in concrete operations.

MATERIALS, PERSONNEL, AND TESTING EQUIPMENT

Materials used in structural concrete construction must be approved by the Department prior to use. If sampling is necessary for approval testing (e.g., curing materials, reinforcing supports, joint materials, reinforcing steel, etc.) the materials must be made available for sampling sufficiently in advance of planned use to allow sampling, testing, and approval prior to use. Under normal conditions, the Department takes approximately ten days for sampling, testing and approving materials. Admixtures not accompanied by a *Certificate of Compliance* must be sampled, tested, and approved prior to incorporation into the concrete mixture. A copy of the Department's *Certificate of Compliance for Concrete Admixtures (03-220-0030)* is reprinted in the Appendix on page B-39. The contractor must be certain that adequate experienced personnel will be available to ensure a smooth and efficient concrete placement operation. The performance of the crew is subject to Department approval; if contractor personnel exhibit substandard performance which threatens to result in an inferior product, the Department may require their removal from the project.

It shall be the responsibility of the contractor to provide a certified technician and all quality control testing equipment. The contractor must provide adequate equipment in satisfactory condition for the performance of all tests required by the Department. The Department may inspect all testing equipment prior to its use. **No concrete shall be batched until the certified technician is present and all testing equipment has been approved.** When quality control testing is to be provided by an independent testing laboratory, it shall be the responsibility of the contractor to assure the Department that all the requirements discussed above will be met at any time placement operations are scheduled.

PRE-POUR CONFERENCE

The contractor or a representative shall be required to attend the pre-pour conferences as established by the project engineer. The contractor shall assure the Department that the certified

technician, concrete supplier, and any contracting parties involved with the placement will attend the pre-pour conferences, as needed.

A checklist of major items to be discussed at a bridge deck pre-pour conference is reprinted in the Appendix on pages B-57 through B-59.

PRE-POUR INSPECTION

The contractor shall notify the DOTD certified inspector when a pour unit is ready for final inspection prior to concrete placement. The certified inspector will then perform the pre-pour inspection. At the time of this inspection, all areas of the pour unit, including forms, reinforcing steel and strike off equipment, are to be ready for concrete placement. All foreign objects and deleterious materials shall be cleaned off and removed from the pour unit prior to placement. **The contractor shall accord the certified inspector adequate time to complete this inspection prior to scheduling concrete placement.**

The certified inspector will notify the contractor of any deficiencies discovered during this inspection. The contractor shall correct all deficiencies to the satisfaction of the engineer. No concrete is to be placed until the pre-pour inspection has been completed and the correction of all deficiencies approved.

WEATHER LIMITATIONS

Refer to Section 901 and 805, *Standard Specifications*, for all weather related and form removal limitations.

POURING OPERATIONS

When falsework, forms, reinforcement, materials, equipment, and personnel have met Department requirements, the contractor can schedule pouring operations. Non-agitator trucks are prohibited for structural and mass concrete, including minor structures.

Forms shall be thoroughly moistened prior to concrete placement. **To establish control and to**

verify batch proportions, the contractor's certified technician or Authorized Field Tester shall test the first concrete out of the first truckload each day for slump and if air entrainment is used, for air content. Slump and air must meet specification requirements prior to the placement of concrete in the forms. When concrete is placed by pumping, concrete must meet all specifications requirements at pump discharge. This procedure will provide the contractor with the opportunity to make any necessary adjustments without excessive waste of material. The results of these tests shall be recorded on the *Batch Certification form* for that truckload. If the slump and air tests indicate that adjustments to the mixture are necessary, these adjustments shall be performed at the plant as soon as possible. The adjustments shall be recorded on the *Batch Certification form* for the appropriate batches. Additional tests for slump and air must be made on subsequent adjusted batches.

If the slump test on the first truckload indicates that the batch is out of specification requirements, on the low side, and it is possible to adjust the batch to bring it into specification range, such adjustments will be allowed.

However, under no circumstances will the maximum water-cement ratio or number of allowable revolutions at mixing speed or applicable specification time limit be exceeded.

If such adjustments are not possible, the batch shall be rejected and no concrete shall be accepted until appropriate plant adjustments are made. The *Batch Certification* for a rejected truckload of mix shall be voided by the Department's certified inspector.

Allowable adjustments do not include excessive rotation, the addition of dry materials, or any other adjustments which may be detrimental to the quality of the mixture. If the mix is obviously deficient by visual observation, it shall be rejected prior to placing the mixture in the forms.

The *Standard Specifications* allow water to be added for truck mixers only in a maximum of two increments at the job site. **Water added to a partial load can cause the water-cement ratio to be exceeded, causing low strengths and poor performance.**

Concrete shall be placed in the forms avoiding segregation of materials or displacement of reinforcement or forms. Concrete shall be thoroughly consolidated immediately after depositing in accordance with the requirements of Subsection 805.03, *Standard Specifications*. Concrete shall be struck off, finished, cured, and protected in accordance with the *Standard Specifications*.

Table 2 – Minimum Placement Rate

Pour Size, yd ³	Minimum Placement Rate, yd ³ /hr
0 - 50	20
51 – 75	25
76 – 125	30
Over 125	40

When placing concrete in bridge decks, the contractor shall provide sufficient supervision, manpower, equipment, tools and materials to assure proper production, placement, and finishing of concrete for each placement in accordance with the minimum placement rates specified in Subsection 805.03, *Standard Specifications*. **If the contractor fails to meet the minimum placement rate, the engineer may reject the placement, and further placement of concrete will not be permitted until corrective measures have been taken to assure the engineer that the minimum placement rate can be met.**

For bridge decks and approach slabs, after the concrete has been struck off, the entire surface shall be checked by the contractor with an approved minimum 10-foot (3.0m) metal straightedge operated parallel to the centerline of bridge and shall show no deviation in excess of 1/8 inch (3mm) from the testing edge of the straightedge. Deviations in excess of this requirement shall be corrected before final finishing. The checking operation shall progress by overlapping the straightedge at least 1/2 the length of the preceding pass. Major deviations shall be corrected by strike-off, with the straightedge being used to correct minor deviations and as a checking device.

Concrete which attains its initial set prior to finishing operations shall be discarded. Initial set is the early strengthening of concrete due to chemical reaction between the water and the cement. Initial set is generally recognized by the Department as occurring when the penetration resistance measured by a penetrometer reaches 500 psi (3450 MPa).

On bridge decks and approach slabs, final finish and texture shall be obtained in accordance with Subsection 805.08.5, *Standard Specifications*, using a metal tine texturing device, except as otherwise noted in Subsection 805.08.5. Contractor personnel shall test the texture of the plastic concrete in accordance with DOTD TR 229. The texturing operation shall meet the satisfaction of the engineer. Problems in achieving the desired texture depth arise primarily from poor control of concrete consistency or texturing the pavement at the wrong time.

Curing shall be in accordance with Subsection 805.06, *Standard Specifications*. A Type 1-D curing compound conforming to Subsection 1011.01, *Standard Specifications* may be used for curing concrete in minor drainage structures and bridge substructures and diaphragms when surfaces do not require a Class 2A finish. Construction joint surfaces shall be wet cured by approved methods. All curing shall begin as soon as possible after concrete placement. Liquid curing membranes (curing compounds) shall be applied as soon as surface moisture has evaporated. The method and application rate of curing compound shall be in accordance with the manufacturer's recommendations, but in no case shall the application rate be less than one gallon per 100 square feet (4 liters per 10 square meters) of surface area. Curing compound may be applied in either one or two increments. If it is applied in two increments, the second application shall follow within thirty minutes of the first. After curing compound is applied, its appearance shall be that of a blank, white sheet of paper. At no time shall curing compound be allowed to come into contact with reinforcing steel or construction joint surfaces. In bridge deck construction, the exposed surface of decks shall be sprayed uniformly with a Type II curing compound immediately after final texturing as an interim curing measure in accordance with Subsection 601.03.10, *Standard Specifications*. Exposed reinforcing steel and joints shall be covered or shielded to prevent contact with curing compound. The moist curing methods conforming to Subsection 805.06.1, *Standard Specifications* shall then be used on the deck.

If rain falls on concrete freshly coated with curing compound before the film has dried sufficiently to resist damage, or if the film is damaged, a new coat of compound shall be applied to affected areas.

When curing with burlap, the exposed concrete shall be covered with two layers of wet burlap immediately after finishing. Burlap shall be kept continuously and thoroughly wet for at least five curing days after concrete is placed, as defined in Subsection 805.06, *Standard Specifications*.

Forms and falsework shall be removed in accordance with Subsection 805.07, *Standard Specifications*.

Every attempt shall be made by the contractor, with the cooperation of the Department's inspection force, to ensure that all materials incorporated into the structure meet the requirements of the specifications. To meet this goal, careful attention must be exercised at both the plant and job site. Ensure that detrimental actions, such as the incorporation of laitance into the deck slab, inclusion of wash water in batches of concrete, adding water to a partially discharged batch, and other practices which affect the uniformity of the materials or compliance with specification requirements, do not occur.

SLUMP AND AIR TESTS

In addition to the tests which shall be run on the first truckload of concrete, the contractor's certified concrete technician or Authorized Field Tester shall perform a minimum of two slump and two air tests per lot. These tests shall be performed in accordance with DOTD Designations: TR 207 and TR 202. Samples for these tests shall be obtained in accordance with DOTD Designation: S 301.

The results of these tests shall be entered on the *Batch Certification* and plotted on the *Control Charts for Slump and Air: DOTD 03-22-5003*. The certified technician will review these charts to determine any trends developing in the mixture. If the mixture is moving toward the outer limits of the specifications, the technician shall make appropriate adjustments at the plant in order to

ensure that the mixture will not move outside of specification limits. **If the mixture does move outside of specification limits, the batch will be rejected and no material accepted until adequate adjustments have been made.**

These control charts must be maintained on a daily basis and be available for review by Department personnel. The original control charts must be kept by Department personnel for project files and be included in the 2059 Review. The contractor may keep copies for his files.

If the test results for slump or air indicate that a batch is outside of specification limits, the same guidelines and procedures used on the first truck are applicable and shall be followed.

UNIT WEIGHT

The contractor shall maintain control of yield. Unit weight tests and calculations shall be performed by the certified technician or Authorized Field Tester as needed, in accordance with DOTD Designation: TR 201. Unit weight is an excellent means to judge consistency and uniformity of concrete from batch to batch. Variation in unit weight of 3 to 4 pounds per cubic foot may indicate a problem in the concrete and warrant further investigation.

STRENGTH DETERMINATION FOR FORM REMOVAL

When the contractor requires compressive strength cylinders to be made and broken in order to determine if the concrete is ready for forms or falsework to be removed, he shall notify the certified inspector. Compressive strength cylinders shall be molded in accordance with DOTD Designation: TR 226 and tested in accordance with DOTD Designation: TR 230. Forms and falsework shall be removed in accordance with Subsection 805.07.

CYLINDER PROTECTION

Portland cement concrete used in structures will be accepted and paid for based on the results of compressive strength determined by testing hardened cylinders which are molded from concrete

delivered to the job site. The contractor may observe the cylinder molding operation. If any discrepancies are noted or if the inspector deviates from the Department's accepted test procedure (DOTD Designation: TR 226), the contractor may protest at that time.

Should circumstances cause the contractor to feel that protective systems in addition to normal procedures are necessary, it will be his responsibility to furnish them. The Department will utilize such systems if they are in conformance with DOTD Designation: TR 226.

DOCUMENTATION AND VERIFICATION

The contractor's certified technician is responsible for maintaining records of all batching operations conducted for DOTD projects. The technician must complete and sign all or part of the following forms:

- *Portland Cement Concrete Plant Report: DOTD 03-22-4040*
- *Batch Certification for Portland Cement Concrete: DOTD 03-22-4028*
- *Aggregate Test Report: DOTD 03-22-0745*
- *Concrete Aggregate Control Charts: DOTD 03-22-5004*
- *Control Charts for Air and Slump of Concrete: DOTD 03-22-5003*
- *Certificate(s) of Compliance for Cement, Fly Ash, Slag, Admixtures, and Curing Compound*

The project engineer shall be provided with a signed copy of all batch records represented by the forms listed above, plus a copy of the *Certificate(s) of Compliance* for each shipment delivered to the plant. Sampling and testing for moisture content and gradation of aggregates and the calculation of batch weight adjustments shall be completed by the certified technician prior to beginning batching operations. Admixtures not accompanied by a *Certificate of Compliance* must be accompanied by a passing test.

RESPONSIBILITIES OF DOTD PERSONNEL

It shall be the responsibility of the Department to provide daily inspection of construction operations. As materials are delivered to the job site, the inspector shall ascertain that they meet all requirements of the plans, contract, and *Standard Specifications*. All materials must be accompanied by proper documentation and are sampled, tested, and approved prior to incorporation in the structure. All precast concrete or timber bridge members shall be checked for the DOTD inspector's stamp of acceptance and inspected for shipping damage. The inspector shall require that all materials at the job site be properly handled and stored.

The inspector shall continually check grade, alignment, and dimensions during the erection of the structure to be certain that all elevations and dimensions are in accordance with the plans. If an Item for Contractor layout is included in the contract, the inspector should review the requirements with the responsible party, assist in answering any questions, do spot checks to help verify accuracy, and bring any noted discrepancies to the attention of the contractor. As forms, falsework, reinforcing steel, etc., are placed; the inspector shall check that all materials are in acceptable condition and that they are placed in accordance with the elevations, dimensions, etc., shown on the plans or shop drawings. Reinforcing steel shall be supported and tied, so that it will not deform when concrete is placed. Forms shall also be checked for tightness and application of form release agent.

MATERIALS

The project engineer shall ascertain that all materials to be incorporated into a project or a concrete mixture have been sampled, tested, and approved in accordance with Department regulations prior to actual use. The project engineer shall also be certain that a mix design has been submitted and approved prior to the beginning of concrete operations. The project engineer shall check the mix design to be certain that it is for the correct class of concrete for its specific use. Materials which have not been approved shall not be used on a project. Concrete for which a mix design has not been approved shall not be placed on a project.

PRODUCTION, PLACEMENT, AND FINISHING OPERATIONS

The certified inspector shall examine all of the contractor's equipment to ensure that it meets the specifications and will perform in a satisfactory manner. In accordance with EDSM No. III.2.5.4, it shall be the responsibility of the project engineer to forward all information provided by the contractor regarding forms, equipment, concrete placement, etc. to the Headquarters Construction Section for approval. Furthermore, in accordance with EDSM No. III.2.5.4, the Headquarters Construction Section is to be notified at least three days in advance of any placement of concrete for bridge decks in order that the Department's inspection team can review the contractor's personnel, equipment, methods, preparation, and controls being utilized when constructing the bridge deck. This inspection shall be performed prior to finalizing preparations for pouring operations. Equipment being used in the production, delivery, and testing of the concrete shall be inspected during production to ensure continuing compliance with Department requirements. Any equipment which fails to perform in a manner satisfactory to the engineer shall be rejected and replaced with equipment which will perform in accordance with Department standards. **No concrete shall be batched until all equipment has been approved.** The Portland Cement Concrete Plant Certification Report: 03-22-4040 and the Portland Cement Concrete Truck Certification Report: 03-22-4045 shall be used as guides during these inspections.

PRE-POUR CONFERENCE

Prior to the initial bridge deck pour on any project; the project engineer shall hold a pre-pour conference. The contractor or a representative, the contractor's certified concrete technician, the DOTD certified inspector, the project engineer, and the concrete supplier shall be required to attend this conference, as needed. The project engineer shall coordinate the scheduling of pre-pour conferences with the contractor to ensure that all affected parties will be present. Other personnel with major responsibilities in pouring operations shall also be required to attend, as necessary.

Topics to be discussed at the pre-pour conference shall include: plant operations; material

requirements; mix design approval; rate of placement; concrete delivery (trucks); method of placement; type of equipment and its inspection; stand-by equipment; finishing; curing; method to locate dowel bars for joint sawing; personnel; minimum quality control and acceptance testing; and the pre-pour inspection. Special conditions which would affect either construction operations or testing (e.g., early opening to traffic or early form removal) and any additional requirements or special problems of the specific placement shall also be discussed.

The contractor and the Department shall agree to actual construction procedures designed to achieve a product that will be in accordance with all plans and specification requirements. If any of these agreed-upon procedures fail to operate properly during actual construction operations, the affected parties shall coordinate and agree to all efforts taken to correct the problems.

The checklist, reprinted on pages B-57 through B-59 in the Appendix, shall be completed and signed by the project engineer attesting that all areas covered by the checklist have been discussed. The checklist shall then be placed in project files.

The project engineer has both the authority and the responsibility to call a pre-pour conference at his discretion prior to any concrete placement when conditions warrant.

PRE-POUR INSPECTION

The certified inspector shall make an in-depth pre-pour inspection prior to every concrete placement. The intent of this pre-pour inspection is to assure that the entire placement is in compliance with specifications and plans, to reinforce routine inspections, and to ensure that previously inspected areas have not been damaged or allowed to deteriorate. **The pre-pour inspection is not to be used to replace day-to-day inspections of individual components.**

This inspection will include checks of form dimensions and elevations, including measuring for allowance for camber (deflection under load); application of form release agent; alignment and tightness of forms; damage to forms; reinforcing steel and their supports, spacing, alignment, ties,

and splices. Steel must be supported so that the mat does not deform during concrete placement. On bridge decks, a dry run of the screed shall be performed over the entire placement area with spot checks for elevations taken using actual measurements. The entire placement is to be in compliance with the agreements reached at the pre-pour conference.

Communications with the contractor shall be such that the inspector will have adequate time to complete the pre-pour inspection prior to the beginning of concrete placement. The inspector will inform the contractor of any deficiencies which are discovered during the pre-pour inspection. These deficiencies shall be corrected to the satisfaction of the engineer prior to batching any concrete. If the inspector does not have adequate time to complete this inspection, including the approval of any corrections, the project engineer and the contractor will be notified so that the placement schedule can be modified.

PLACEMENT OPERATIONS

The certified inspector shall observe the contractor's placement operation and ensure that the contractor complies with all requirements of the specifications.

The Department's certified inspector shall be certain that the contractor's certified technician or Authorized Field Tester performs slump and air tests on the first truckload of mixture delivered to the job site, prior to allowing placement of mixture. **If the mixture is not in accordance with the requirements of the specifications, do not place any concrete until appropriate adjustments have been made.** If the mixture is obviously deficient by visual observations, the certified inspector shall reject the batch. The certified inspector shall void the Batch Certificate of any truckload of mix which is rejected.

WEATHER LIMITATIONS

Refer to Section 901 and 805, *Standard Specifications*, for all weather related and form removal limitations.

PERSONNEL AND TESTING EQUIPMENT

The project engineer's representative on the project will be certified in the area of Structural Concrete Inspection. All equipment used by Department personnel to perform acceptance tests will be furnished by the Department and will conform to the standards established by the appropriate approved Department test procedures.

ACCEPTANCE TESTS

SLUMP AND AIR CONTENT

The *Materials Sampling Manual* requires a minimum of one acceptance test per lot for slump and for air during structural concrete operations. These tests are to be performed in accordance with TR 202 and TR 207. They must be performed under the direction of the Department's certified inspector or Department's authorized field tester from samples of material obtained independently in accordance with DOTD Designation: S 301. The observance and documentation of the contractor's quality control testing operation cannot be substituted for acceptance testing.

The results of the inspector's acceptance tests will be recorded on the *Structural Concrete Tests Form: DOTD 03-22-0740*. An example of a *Structural Concrete Tests Form* is reprinted in the Appendix on page B-55.

When concrete is being placed by pumping, samples for acceptance tests for slump and air for the operation shall be taken from the discharge end of the pump. The purpose of sampling the concrete at this point is to ensure that the concrete being placed in the forms meets specification requirements and that the pumping operation and configuration is not causing a significant change in the quality of the concrete. Air content, in particular, can be greatly influenced by both the pumping conditions and pump boom configuration. If the concrete sampled at pump discharge is outside of specifications, halt placement operations until the problem can be identified and corrected. If acceptance test results are not within specifications, the material represented by these tests will be rejected and the contractor's certified technician must be notified. The certified inspector will require that adjustments be made to bring future batches into

specifications. When a mixture fails acceptance testing, additional tests will be performed on subsequent batches to be certain that material which does not meet specifications will not be incorporated into the project.

COMPRESSIVE STRENGTH AND SURFACE RESISTIVITY

Portland cement concrete used in structural items is accepted and paid for based on the results of compressive strength determined by testing hardened cylinders which are molded from concrete delivered to the job site. These cylinders shall be molded by qualified DOTD personnel under the direction of the Department's certified inspector in accordance with DOTD Designation: TR 226 from concrete sampled in accordance with DOTD Designation: S 301. The cylinders will be cured and tested for compressive strength by the district laboratory in accordance with DOTD Designation: TR 230. Two batches will be sampled for cylinders per lot; three cylinders will be molded per batch. Thus, six cylinders normally represent a lot. However, if operations are halted before six cylinders can be molded, a lot shall be represented by a minimum of three cylinders.

Concrete will be accepted on a lot basis in accordance with Table 901-3, (Master Proportion Table for Portland Cement Concrete) Section 901, *Standard Specifications*.

The contractor may observe the cylinder molding operation. If any discrepancies are noted or if the inspector deviates from the Department's accepted test procedure, the contractor may request that the cylinder in question be discarded and another prepared.

All three cylinders in a set shall be prepared from the same batch of concrete. Therefore, if replacements are necessary and there was not enough material taken at the time of sampling to mold a complete set of three cylinders, any cylinders already molded shall be disposed of, and another batch sampled for the preparation of a set of three cylinders.

The protection, curing, and transporting of the cylinders is the Department's responsibility. The inspector must take all reasonable measures to prevent cylinder damage. Field curing of

cylinders shall be done in accordance with DOTD Designation: TR 226. Alternate curing procedures may be taken to reduce environmental impacts on cylinders, with the approval of the Project Engineer.

The molded cylinders will be delivered to the district laboratory as soon as practical after 20 hours have elapsed. Protect cylinders during transit by transporting in padded, partitioned containers and restrain to prevent movement. Perform surface resistivity tests on all six cylinders per DOTD TR 233 prior to performing compressive strength tests.

When computing the average compressive strength for a lot under the *Standard Specifications*, both high and low critical strengths for a set of cylinders must be identified. The critical strengths are defined as those values greater than fifteen percent above and below the average for the three cylinders. When the compressive strength of an individual cylinder is outside of the range of the critical strengths, that cylinder is considered as an Outlier. Outliers are not to be used in the batch average. Should this be the case, the batch average shall be recalculated using the remaining cylinders. If two cylinders are outside of the critical strengths, the compressive strength of the one remaining cylinder shall be used to determine the average strength of the lot. If all three cylinders are outside of the critical strength, an investigation should be made. Examples of compressive strength calculations are located beginning on page A-45.

COMPRESSIVE STRENGTH CYLINDERS FOR FORM REMOVAL

When the contractor requests compressive strength cylinders for form removal determination, they shall be made by Department personnel under the direction of the certified inspector. Cylinders shall be made and cured in accordance with DOTD Designation: TR 226. A sufficient number of cylinders shall be made so that successive sets of three cylinders can be broken until such time as the cylinder breaks indicate that the concrete has attained the required compressive strength. Form removal shall be determined in accordance with Table 805-6 or Table 805-7 of the *Standard Specifications*.

CHAPTER 8 - SURFACE TOLERANCE TESTING

SURFACE TOLERANCE

The DOTD Roadway Inspector shall check cross slope, grade, and transverse surface tolerance in accordance with *Section 601.03.11 Surface Tolerance (IRI)*.

PROFILER CERTIFICATION

The Materials and Testing Section (MATLAB) certifies Inertial Profilers annually. The Materials Section will contact Contractors whose Profilers have an established history with DOTD for scheduling the annual certification. Any new Contractors shall call the Materials Section at (225) 248-4168 to schedule an appointment for certification. ProVAL software is required to analyze data. ProVAL is available free of charge at www.roadprofile.com. During certification, the Contractor is required to provide all data collected from the test track to the Materials Section representative. Data is provided to DOTD on a Contractor supplied USB storage device and shall contain the following formats: raw data, header file, .ERD, and .PRO. Contractors are encouraged to have their equipment (lasers and accelerometer) calibrated by the Profiler manufacturer prior to attending the certification.

LONGITUDINAL SURFACE TOLERANCE TESTING

Pre-op Tests and Observations

The DOTD Roadway Inspector shall ensure that the contractor is using a DOTD Certified Inertial Profiler for quality control and quality acceptance. Profilers must be certified and operated in accordance with DOTD TR 644 and Section 601.03.11. To verify that the profiler is certified to be used on a job, the DOTD roadway inspector will check the certification sticker (Appendix B-89) and certificate (*LA DOTD Profiler Inspection and Certification*) (Appendix B-87 and B-88). The certification sticker will display the date of certification renewal for IRI and/or PI, high pass and low pass filter settings, the rated speed, the correct tire pressure, and the technician certifying

the equipment. The profiler inspection and certification certificate contains additional general information, inspection, and testing information, and static test results.

The profiler settings shall match the certification settings during profiler operation on DOTD projects. Since the settings on the profilers *can* be changed by the operator, it is imperative that the certification settings be verified before quality acceptance profiling and accepting data from the contractor. The settings directly affect the data collected. By changing the settings, the data collected can be manipulated.

Before a profiler is used, the following pre-operation tests shall be performed by the contractor, witnessed by the DOTD inspector, each **day of testing**:

1. Tire Pressure Check - The distance measuring system of the profiler is based on revolutions of the wheel and the rolling radius of the tire. The rolling radius of a tire is dependent upon the air pressure. A tire that is fully inflated has a larger rolling radius than one that is not fully inflated. Tire pressure affects the number of revolutions made in a given distance. **The tire pressure shall be checked each morning on the cold tire and adjusted if necessary.** The correct tire pressure at which each profiler is to be run may be found on the *LA DOTD Profiler Inspection and Certification* form. The tires must be inflated to the specified pressure used on the day of certification.

2. Vertical Calibration - This test is performed on a stationary profiler by placing various plates under the lasers and taking readings at each block height. The blocks shall have a thickness of 0.25 in., 0.50 in., and 1.00 in. (1.00 in., 2.00 in., and 3.00 in. depending on the make and model of profiler). Block thickness is verified and reported on the profiler certification report. The vertical calibration check ensures that the height sensor is performing properly. The height sensor measures vertical distance from the sensor to the roadway. The average difference per block thickness shall not exceed 0.01 in. for any block size. The operator shall not be in the unit during this test.

3. Bounce Test - It is performed on a **stationary profiler while the operator bounces the unit (according to manufacturer's recommendation)**. This test is performed in order to check that the accelerometers and height sensors are functioning properly. Accelerometers measure vertical acceleration and are mounted above the height sensor. If the accelerometers are working properly, the unit will filter out any bouncing or excess movement of the unit itself during the actual surface roughness testing. The profiler will display the Bounce Test results with either a "pass" or "fail" display or by graphical symmetry, depending on the make/model.

The profiler should then be driven for 15 minutes to warm the tires prior to Horizontal Calibration.

4. Horizontal Calibration - This procedure calibrates the horizontal measuring system of the profiler. This calibration is performed by running the profiler over a measured distance of at least 528 ft. (1,000 ft. minimum for Dynatest). It is recommended that this measured distance be increased for longer projects. Whoever is going to be in the profiler during the testing process must be in the profiler during the horizontal calibration. The calibration adjusts for weight distribution. The profiler will display the horizontal calibration results, which must be within 0.1 percent of the measured distance.

5. Odometer Check - This check measures the distance traveled by the profiler and verifies the horizontal calibration. This test needs to be performed by **running the same measured path** that was used for the horizontal calibration. Distance is usually measured by a pulsar attached to a wheel(s). Rotation of the wheel is measured by detection of pulses as the wheel rotates and the notches pass. Each pulse is directly associated with a fixed travel distance through the rolling radius of the tire.

Immediately following these Pre-Op Tests, perform the run for surface tolerance pay.

NOTE: All results of the **Pre-Op Tests** shall be printed (or clearly displayed in data on the USB flash drive) and turned in to the DOTD inspector with the IRI data. The date and time of the test will be indicated with the pre-op results.

Surface tolerance quality is determined by an International Roughness Index (IRI) and is measured in units of inches per mile.

SURFACE TOLERANCE PAY

Once Pre-op Tests and setting verification are complete, the contractor shall measure and report the average IRI value for each wheelpath for each lane for the entire length of the project, minus any exceptions and exclusions. A wheelpath is defined as 3 ft. ($\pm\frac{1}{2}$ ft.) on either side of the longitudinal centerline of the lane being tested. Percent pay is determined in accordance with Table 601-1 using the averaged IRI. Corrective grinding is only allowed to achieve 100-percent pay, not for bonus pay. The measurement shall be performed by the contractor in the presence of a Department qualified representative, by the Materials and Testing Section, or by a private company approved by the Department. **This Department representative must ride with the contractor during the profile data collection process.**

CHAPTER 9 - PAYMENT CALCULATIONS

PAVEMENT

Payment for PCC pavement will be on a lot basis at the contract unit price per square yard. When payment adjustments are made for more than one deficiency, they shall be cumulative.

If any section of pavement does not meet specifications requirements, an adjustment in unit price for the lot will be made in accordance with the Payment Adjustment Schedule, Table 601-1, Section 601 of the Department's specifications.

Payment adjustments shall be cumulative. ¹At the option of the Department after investigation. ³As defined in Subsection 601.11 using an approved profilograph.

Table 601-1E Payment Adjustment Schedule

Table 601-1 ¹ Pavement Adjustment Schedule for Mainline Longitudinal Surface Tolerance, Maximum International Roughness Index, inches per mile					
Percent of Contract Unit Price		102% ²	100%	98%	50% or Remove and Replace ³
Category I: Design Speed ≥60 mph	IRI in/mi	≤65	≤75	76-84	≥85
Category II: Design Speed ≥45 mph and <60 mph	IRI in/mi	≤75	≤85	86-94	≥95
Category III: Design Speed <45 mph	IRI in/mi	N/A	≤115	116-129	≥130

¹Applies to each travel lane for the entire project's length.
²Incentive Pay Requirements:
 Must equal or be less than the average IRI indicated for bonus payment.
 Grinding is not allowed to achieve incentive payment but requirements for 601.03.11.3.2 must be met.
³At the option of the Chief Engineer.

COMPRESSIVE STRENGTH AND THICKNESS

All portland cement concrete pavements are subject to payment adjustments based on the results of tests for compressive strength and thickness performed on cores taken from pavement lots. Payment adjustments are established by Table 601-3 of the specifications.

Additionally, pavement travel lanes are subject to a payment adjustment based on the results of tests for longitudinal surface tolerance. These payment adjustments come at the completion of the project. An example of Surface Tolerance payment adjustment is covered later in this chapter.

If any payment adjustment is applicable, it will be applied to the entire lot. If more than one test (thickness or compressive strength) results in a payment adjustment, the cumulative payment adjustment will be applied to the entire lot.

PAYMENT ADJUSTMENTS TO LOT SEGMENTS BASED ON COMPRESSIVE STRENGTH OR THICKNESS

The specifications also require payment adjustments to be applied to individual segments of paving lots that do not conform to acceptance requirements for compressive strength or thickness.

COMPRESSIVE STRENGTH

If any individual core has a compressive strength of less than 3000 psi (20.7 MPa), a second core will be taken and tested in accordance with the requirements of DOTD Designation: TR 225. The results of the second core will be used in calculating the average compressive strength of the lot and in determining the percent pay.

When the Department determines that any pavement area(s) represented by a core(s) with a compressive strength of less than 3000 psi (20.7 MPa) will be left in place, payment will be calculated by averaging the percent payment for each of the five portions of the lot, even though

the lot average is above 3000 psi (20.7 MPa). Therefore, individual core results below specifications limits will result in the payment for that lot being adjusted, even if the lot average meets the requirements of Table 601-3, Subsection 601.03.14.2.1 of the specifications. An example can be found on page A-53 of the Appendix.

THICKNESS

If any pavement area represented by a core found to be deficient in thickness by more than one inch is to be left in place, payment will be calculated by averaging the percent payment for each of the five lot portions, even though the lot average for thickness is within the tolerance allowed by Table 601-3. An example can be found on page A-54 of the Appendix.

Lots for which a payment adjustment is applicable based on the lot average of thickness results and which also have a core(s) with a thickness **deficiency** greater than 1.00 inch (25 mm) will be assessed an additional payment adjustment for the unsatisfactory thickness represented by the failing cores, if that segment of the lot is allowed to remain in place. Calculations for this payment adjustment will be the same as for lots which qualify for 100% payment based on lot average.

CHAPTER 10 - APPROACH SLABS

The approach slab shall be constructed by placing structural (class A) concrete on a prepared subgrade. The inspection requirements for the prepared subgrade shall be as discussed in the chapter that covers portland cement concrete pavement. Aggregate material shall be sampled and approved prior to placement. The documentation, inspection of forms, reinforcement, concrete placement, sampling, testing, etc., shall be as discussed in the chapter that covers structural concrete operations. Surface tolerance requirements shall be in accordance with Subsection 805.03.4, *Standard Specifications*. Acceptance and payment for concrete approach slabs will be made on a lot basis. A lot will be considered as a complete approach slab or an identifiable pour that is completed in one day. Two random batches will be sampled for each lot, and three cylinders molded for each batch. The six cylinders per lot will be tested for compressive strength in accordance with Section 901, *Standard Specifications*. In the event of sudden cessation of operations, a minimum of three cylinders will constitute a lot. Acceptance and payment for each lot will be made in accordance with Table 901-4 and Table 901-6.

For pile supported approach slabs, inspection procedures for pile driving, forms, embankment, reinforcement, etc., shall be the same as for structural operations.

Concrete for bolster blocks shall be structural (Class A) or paving (Type B or D) and accepted under the requirements of Section 901,

CHAPTER 11 - MINOR STRUCTURE CONCRETE

The essential difference between structural classes of concrete and minor structure concrete is the lot size, sampling requirements, and compressive strength requirements for payment.

CERTIFICATION

A plant supplying minor structure concrete to the Department must meet all plant certification requirements, with the exception of a plant laboratory. Scales must meet all requirements of Section 901, *Standard Specifications*. The *Certification Report for Scales and Meters (03-22-3065)* must be completed and on file at the district laboratory. All trucks used to deliver minor structure concrete must be certified and must meet all other requirements of Section 901, *Standard Specifications*.

CONTRACTOR'S QUALITY CONTROL

For minor structure concrete only, the contractor will not be required to have a Certified Concrete Technician or Authorized Concrete Field Tester, but shall implement a quality control testing program which shall ensure that the concrete produced meets the requirements of the specifications. This policy is different from that established for structural concrete produced under Section 901, wherein the Department specifies the quality assurance program which the contractor must follow and monitors the contractor's adherence to it on a continual basis.

The requirements for all materials and mixing of the concrete shall be in accordance with Section 901, *Standard Specifications*. Control tests shall be in accordance with the *Materials Sampling Manual*.

ACCEPTANCE AND DOCUMENTATION

An accepted mix design is required for all concrete. Adequate documentation of mix components must be available at the plant for the review of Department personnel at all times. All trucks must present a properly completed *Batch Certification for Portland Cement Concrete: 03-22-4028* to the Department's inspector. Sampling and testing by the Department shall be in accordance with the *Materials Sampling Manual*. The project engineer's representative shall be certified in the area of Structural Concrete and shall direct all inspection, sampling and testing. Acceptance tests by the Department shall be entered on the *Structural Concrete Tests: 03-22-0740*. A set of three cylinders for compressive strength testing shall be made for each lot of 50 cubic yards of the same class of concrete on the project. This set of cylinders may represent more than one day's pour. The Acceptance and Payment Schedules, Table 901-5, for Cast-in-Place Minor Structure Concrete in Section 901 of the Department's specifications allow only 100 percent payment or 50 percent payment or removal at the Department's discretion.

Appendix in separate document